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# REPORT

ON THE

# DANISH OCEANOGRAPHICAL EXPEDITIONS 1908-1910

TO THE

# MEDITERRANEAN AND ADJACENT SEAS

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LEADER OF THE EXPEDITIONS

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Vol. II (Biology), H. 2: Siphonophorae by Henry B. Bigelow and Mary Sears.
- - — D. 6: Euphausiacea by Johan T. Ruud.
- - — E. 1: Pelagic Polychaetes of the families Aphroditidae, Phyllodocidae, Typhloscolecidae and Alciopidae by Elise Wesenberg-Lund.

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# List of other Papers resulting in whole or in part from the Cruises of the Danish Research-Steamer "Thor" in the Atlantic and Mediterranean.

## 1. Hydrography.

J. P. JACOBSEN, in Schmidt, Nielsen og Jacobsen: Fra den danske oceanografiske Expedition til Middelhavet i Vinteren 1908—1909. (Geografisk Tidsskrift, 20. H. VI, København 1910).

MARTIN KNUDSEN: Danish Hydrographical Investigations at the Faroe Islands in the Spring of 1910. (Meddelelser fra Kommissionen for Havundersøgelser, Serie: Hydrografi, II, No. 1, København 1911.

J. N. NIELSEN: Hydrography of the Waters by the Faroe Islands and Iceland during the cruises of the Danish research-steamer "Thor" in the summer 1903 (ibid. I, No. 4, 1904).

— Contributions to the Hydrography of the Waters north of Iceland (ibid. I, No. 7, 1905).

— Contribution to the Hydrography of the north-eastern part of the Atlantic Ocean (ibid. I, No. 9, 1907).

— Contribution to the understanding of the currents in the northern part of the Atlantic Ocean (ibid. I, No. 11, 1908).

— in Schmidt, Nielsen og Jacobsen: Fra den danske oceanografiske Expedition til Middelhavet i Vinteren 1908—1909 (Geografisk Tidsskrift, 20, H. VI, København 1910).

— Sur les températures des grandes profondeurs particulièrement dans la Méditerranée. Note préliminaire (Bulletin de l'Institut Océanographique, No. 209, Monaco 1911).

— Hydrografiske Undersøgelser i Middelhavet; De danske oceanografiske Expeditioner i 1908—1910, København 1913.

Numerous observations, sections, etc. from the "Thor" Expeditions in the Atlantic have been published in: Bulletin Hydrographique du Conseil Permanent International pour l'Exploration de la Mer, København 1902 and following years.

## 2. Biology.

VILH. EGE: On the postlarval stages of the species of *Paralepis* inhabiting the North Eastern part of the Atlantic incl. the Mediterranean (Videnskabelige Meddelelser fra Dansk naturhistorisk Forening, Vol. 69, København 1918).

P. JESPERSEN: Contributions to the Life-History of the North Atlantic Halibut (*Hippoglossus vulgaris* Flem.) (Meddelelser fra Kommissionen for Havundersøgelser, Serie: Fiskeri, Bind V, No. 5, København 1917).

— On the Occurrence of the Postlarval Stages of the Herring and the "Lodde" (*Clupea harengus* L, and *Mallotus villosus* O. F. M.) at Iceland and the Færoes (ibid. Bind VI, No. 1, 1920).

P. JESPERSEN and Å. VEDEL TÅNING: Some Mediterranean and Atlantic *Sternoptychidae*. (Videnskabelige Meddelelser fra Dansk naturhistorisk Forening, Vol. 70, København 1919).

C. H. OSTENFELD: *Thorosphaera*, eine neue Gattung der Coccolithophoriden (Berichte der deutschen Botanischen Gesellschaft, Bd. 28, Berlin 1910).

OVE PAULSEN: Plankton-Investigations in the Waters round Iceland in 1903 (Meddelelser fra Kommissionen for Havundersøgelser, Serie: Plankton, I, No. 1, København 1904).

— On some Peridineae and Planktons Diatoms (ibid. I, No. 3, 1905).

— Studies on the biology of *Calanus finmarchicus* in the waters round Iceland (ibid. I, No. 4, 1906).

— Plankton Investigations in the Waters round Iceland and in the North Atlantic in 1904 (ibid. I, No. 8, 1909).

— The plankton on a submarine bank (in Biologiske Arbejder tilegnede Eug. Warming d. 3. Nov. 1911, København 1911).

C. G. JOH. PETERSEN: On the Larval and Postlarval Stages of the Long Rough Dab and the Genus *Pleuronectes* (Meddelelser fra Kommissionen for Havundersøgelser, Serie: Fiskeri, I, No. 1, København 1904).

C. G. JOH. PETERSEN: Larval Eels (*Leptocephalus brevirostris*) of the Atlantic Coasts of Europe (ibid. I, No. 5, 1905).

— On the young stages of the Genus *Zeugopterus* (Report of the Danish Biological Station, XII, København 1905).

— On the Larval and Post-Larval Stages of some *Pleuronectidae Pleuronectes, Zeugopterus*) (Meddelelser fra Kommissionen for Havundersøgelser, Serie: Fiskeri, II, No 1, København 1906).

— On the Larval and Postlarval Stages of some *Pleuronectidae* (*Zeugopterus, Arnoglossus, Solea*) (ibid. III, No. 1, 1909).

LOUIS ROULE: Étude sur les formes larvaires Tiluriennes de Poissons Apodes recueillies par le "Thor" (Annales de l'Institut Océanographique, T. VI, Fasc. 2, Monaco 1913).

JOHS. SCHMIDT: Fiskeriundersøgelser ved Island og Færøerne i Sommeren 1903 (Skrifter udgivne af Kommissionen for Havundersøgelser, No. 1, København 1904).

— On Pelagic Post-Larval Halibut (*Hippoglossus vulgaris* Flem. and *H. hippoglossoïdes* [Walb.]) (Meddelelser fra Kommissionen for Havundersøgelser, Serie: Fiskeri, I, No. 3, København 1904).

— The Pelagic Post-Larval Stages of the Atlantic Species of *Gadus*, Part I (ibid. I, No. 4, 1905).

— On the Larval and Post-Larval Stages of the Torsk (*Brosmius brosme* [Ascan.]) (ibid. I, No. 8, 1905).

— The Pelagic Post-Larval Stages of the Atlantic Species of *Gadus*, Part II (ibid. II, No. 2, 1906).

— On the Pelagic Post-Larval Stages of the Lings (*Molva molva* [Linné] and *Molva byrkelange* [Walb.]) (ibid. II, No. 3, 1906).

— On the Larval and Post-Larval Development of the Argentines (*Argentina silus* [Ascan.] and *Argentina sphyræna* Linné with notes on *Mallotus villosus* [O. F. Müll.]) (ibid. II, No. 4, 1906).

— Contribution to the Life-History of the Eel (*Anguilla vulgaris* Turt.) (Rapports et Procès-Verbaux du Conseil International pour l'Exploration de la Mer, Vol. V, No. 4, København 1906).

— Marking Experiments on Plaice and Cod in Icelandic Waters (Meddelelser fra Kommissionen for Havundersøgelser, Serie: Fiskeri, II, No. 6, København 1907).

— On the Post-Larval Development of the Hake (*Merluccius vulgaris* Flem.) (ibid. II, No. 7, 1907).

— On the Post-Larval Development of some North Atlantic Gadoids (*Raniceps raninus* [Linné] and *Molva elongata* [Risso]) (ibid. II, No. 8, 1907).

— On the Post-Larval Stages of the John Dory (*Zeus faber* L.) and some other Acanthopterygian Fishes (ibid. II, No. 9, 1908).

— Remarks on the Metamorphosis and Distribution of the Larvae of the Eel (*Anguilla vulgaris* Turt.) (ibid. III, No. 3, 1909).

— On the Occurrence of Leptocephali (Larval Muraenoids) in the Atlantic W. of Europe (ibid. III, No. 6, 1909).

— On the Distribution of the Fresh-Water Eels (*Anguilla*) throughout the World, I. Atlantic Ocean and Adjacent Regions (ibid. III, No. 7, 1909).

— The Distribution of the Pelagic Fry and the Spawning Regions of the Gadoids in the North Atlantic from Iceland to Spain (Rapports et Procès-Verbaux du Conseil International pour l'Exploration de la Mer, Vol. X, No. 4, København 1909).

— Exposé sommaire des travaux de l'expédition océanographique danoise dans la Méditerranée (1908—1909) (La Géographie, XXI, 2, Paris 1910).

— *Leptocephalus hyoproroïdes* and *Lept. thorianus* (Zoologischer Anzeiger, XXXVI, No. 2—3, Leipzig 1910).

— Résultats préliminaires de l'expédition océanographique danoise dans l'Atlantique et la Méditerranée pendant l'été 1910 (La Géographie, Paris 1911).

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REPORT ON THE DANISH OCEANOGRAPHICAL EXPEDITIONS 1908—10
TO THE MEDITERRANEAN AND ADJACENT SEAS

**Vol. II. Biology.**

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H. 2.

# Siphonophorae.

By

Henry B. Bigelow and Mary Sears.

With 83 figures in the text.

Published March 16, 1937.

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# INTRODUCTION.

The siphonophores described in the following pages were collected on the cruises of the "Thor", 1908—1909, and 1910, in the Atlantic between the English Channel and the Straits of Gibraltar, and during the intensive campaigns of towing throughout the Mediterranean. The locations of the stations are shown in Figure 1.

The collection does not contain any novelties, nor was it likely that any would be encountered, for the siphonophore-fauna has been more intensively examined in these regions than in any other part of the sea. And the condition of such of the long-stemmed physophores as were collected bears out the experience of previous expeditions, that special precautions must be taken, if these extremely fragile animals are to be brought back in good enough condition for positive identification. But the collection adds to previous knowledge of the morphology of several of the Calycophorae, and it is especially instructive from the distributional standpoint (p. 68), for it affords the first general survey of the abundance, and of the regularity of occurrence, of the common species of siphonophores over the Mediterranean basins as a whole, most of the earlier investigations having been carried out either close to the shore, as at Naples and Villefranche, or in tributary waters, e. g., Aegean Sea and Adriatic Sea. In fact, it affords the first basis for detailed regional and seasonal study for the siphonophores, of any sea-area of comparable extent. And this also applies to vertical distribution (p. 69). It is likewise the largest collection of siphonophores that had been made up to that time, numbering upwards of 95,000 colonies or loose nectophores.

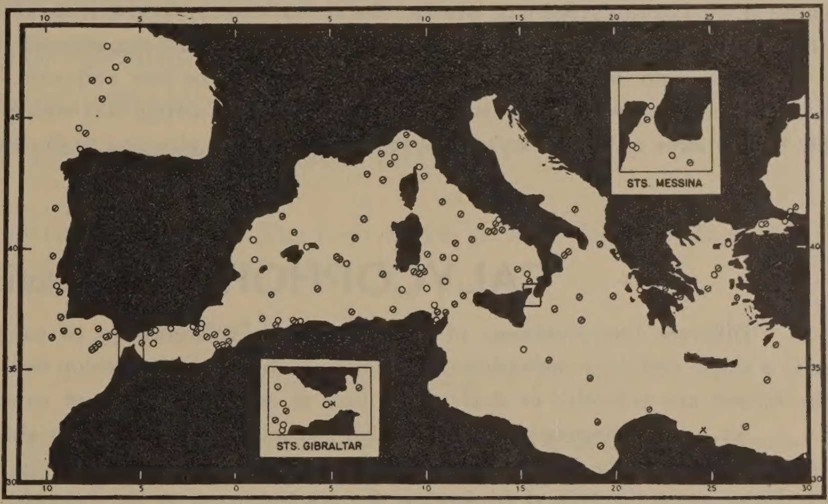

Fig. 1. Positions of "Thor" towing stations, 1908—1909, and 1910. ○ = stations where tows were made with 65 meters of wire out or less; ⊘ = stations where tows were also made with 300 meters of wire out or more; × = stations where tows were made with 300 meters of wire out, or more, but not shallower.

# PART I. SYSTEMATIC.

## TERMINOLOGY.

Much confusion has been introduced into siphonophore literature, by the use, by different authors, of different terminologies in their descriptions. These disagreements have come in part from the custom of using the terms "ventral", "dorsal", "anterior" and "posterior", borrowed from the terminology of bilaterally symmetrical animals, to describe the structures of animals that are not bilateral. And confusion has been added, by the adjustment of terminology by different students, to express their views as to homologies, mode of development, etc., within the group.

This last viewpoint has most recently been upheld by Moser (1925, p. 21). Since, however, the primary purpose of descriptive terminology is to add precision to written accounts, and especially to make comparable the accounts by different authors, it seems to us preferable to use it in a strictly descriptive way, without any implication whatever as to our opinions regarding phylogeny or the mechanics of development.

Totton (1932, p. 318) has recently argued that "since all the nectophores of polygastric stages of Calycophorae appear to be homologous structures, it is as well to use the same terms throughout for comparable parts". He therefore followed the old custom of using the term "dorsal" for the abaxial, "ventral" for the axial side of all nectophores, whether superior or inferior[1]. And this procedure is adopted here, as in earlier papers (Bigelow 1911b, 1913, 1918, 1931).

The question which side of a calycophorid nectophore is to be named "right", which side "left", depends on whether the oral (basal) end of the bell is to be regarded as anterior from the standpoint of orientation, as by Totton (1932), or whether the aboral (apical) end is to be so named, as by many authors (Chun, 1885—1913; Bigelow, 1911b, 1918; and Moser, 1925 among others). The latter course is followed here.

This same terminology is employed for bracts or free eudoxids, in this case the apical or anterior end (determining which face is "left", which "right") being that which was uppermost — (i. e. nearest to the nectophores of the colony) while the bract was still attached to the stem (Moser, 1925, Fig. 5).

# CALYCOPHORAE Leuckart 1854.

Different interpretations of the phylogenetic relationships of such of the calycophorids as develop only a single definitive nectophore, in relation to those which develop two or more nectophores (i. e., whether the former are primitive or derivative), lead to essentially different subdivisions of the group.

An earlier discussion (Bigelow 1911b) led to the conclusion that they are primitive, *Sphaeronectes* being ancestral to the Hippopodiidae, and that available evidence on the whole favors a similar relationship for *Muggiaea* to the typical Diphyidae, for *Nectopyramis* to the Prayidae, for *Enneagonum* (*Cuboides* auct.) to the Abylidae: Bigelow (1911b) therefore, followed Chun (1897) in referring all monophyid calycophores to a single family, Sphaeronectidae. Moser (1925), who next revised the Calycophorae, also regarded *Sphaeronectes* and *Muggiaea* as primitive forms because of their monophyid character. But she considered *Enneagonum* as derived by loss of the second nectophore from the Abylidae, though with some reservation. Most recently, Totton (1932, p. 328) has argued that there are no sufficient grounds for assuming "that monophyism was ancestral," (i. e. that *Muggiaea*- and *Enneagonum*-like forms gave rise to diphyids and abylids respectively).

So far as *Sphaeronectes* is concerned, no evidence has come to hand to controvert the seemingly ancestral character. Quite apart from its possession of only a single nectophore, and whether or not its single definitive nectophore be actually homologous with the larval bell of the Hippopodiidae, as one of us has earlier argued[2], nevertheless it shows little sign of progressive specialization. This reasoning, however, does not apply to *Enneagonum*, for while the latter seems certainly allied to the Abylinae, its single definitive bell is not only homologous with the latter in all essentials, as Totton has shown, but is more complex in architecture than is the corresponding bell of any member of that group. Whether or not its monophyism be more primitive than the diphyism of the Abylinae (i. e., whether or not it is an abylid with the second bell aborted), it is clearly more closely allied to the Abylinae than it is to the primitive *Sphaeronectes.*

---

[1] Moser (1925), who regards the inferior nectophore of a diphyid or of a prayid as homologous with a sterile gonophore, names its abaxial side "ventral", its axial, "dorsal", i. e., she reverses the terminology she uses for the superior nectophores.

[2] Moser (1925, p. 75) concludes that it is not, on the ground that it is situated on the dorsal side of the stem.

The arguments adduced by TOTTON (1932) similarly favor removing *Muggiaea* from family-unity with *Sphaeronectes.* Not only do they strengthen the view, long held, that this genus is closely allied to the Diphyinae, but he has also shown that the several species of *Muggiaea,* are more closely allied to various other Diphyinae, than they are to one another.

TOTTON (1932, p. 328) therefore discards "as a single natural group an association of all the monophyid species", and definitely unites *Enneagonum* with the Abylinae, *Muggiaea* with the Diphyinae, and *Nectopyramis* with the Prayidae. In the light of present knowledge, this scheme is a decided advance over the older schemes followed by CHUN (1897), by MOSER (1925) and by BIGELOW (1911 b), hence is adopted here, as it already has been by LELOUP (1933, 1934, 1935).

# PRAYIDAE Kölliker 1853.

## NECTOPYRAMIDINAE Bigelow 1911.

## NECTOPYRAMIS Bigelow 1911.

### NECTOPYRAMIS THETIS Bigelow 1911.

Figs. 2—5.

*Nectopyramis thetis,* Bigelow, 1911 a, p. 338, Pl. 28, Fig. 1—4; 1911 b, p. 346; Moser, 1925, p. 115; Leloup, 1932 a, p. 1, Fig. 1—5; 1933, p. 10, Pl. 1, Fig. 11—15.

Material.

St. 76. 47°01′ N., 5°48′ W. 10. III. 1909.
Y. 1600 m w. 1 eudox.

St. 91. 35°53′ N., 7°26′ W. 18. VI. 1910.
Y. 1600 m w. 1 nectoph.

Colony. The one nectophore (Fig. 2), though much crumpled and twisted, is in good enough condition to show that it agrees in all essential respects with the two examples of the polygastric generation which have been taken previously. Its general form is similarly pyramidal. And while its apical and its two dorsolateral angles are somewhat more pronounced and acute than in the type specimen, this difference probably represents nothing more than a difference in the degree of contraction which the respective specimens underwent in preservation. Especially close is the agreement in the canalization, each of the specimens so far seen having shown the arrangement shown in dorsal view in Fig. 2, in which the somatocyst system consists of one ascending branch, extending to the apical angle of the bell, and one descending, which gives off a lateral branch to each side, shortly below its point of origin. For lateral views, and also an earlier dorsal view see BIGELOW, 1911 a, Pl. 28, Figs. 1—2, LELOUP, 1933, Fig. 11. Each of these lateral trunks then divides dichotomously, one of the resultant branches curving around the hydroecial wall, nearly to the ventral margin of the latter, the other running out through the gelatinous substance to the lateral corner of the bell. Beyond its point of subdivision, the main descending trunk continues basally, along the dorsal face of the hydroecium, giving off, first, the dorsal subumbral canal, then after a considerable interval, the two lateral subumbrals, then (again after some interval) the ventral

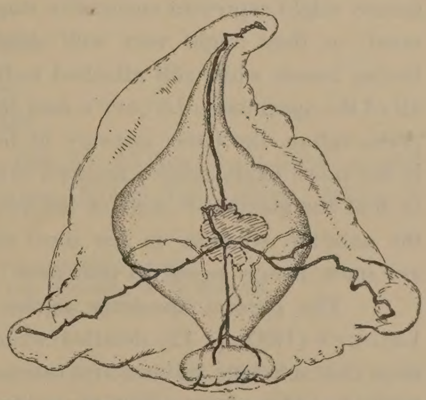

Fig. 2. *Nectopyramis thetis*; dorsal view of nectophore, 7 mm. high; "Thor" St. 91.

subumbral. Beyond the latter point of subdivision it still continues for some distance. Sundry small variations exist among the three recorded specimens, in the degree of jaggedness of the margins of the canals, and in the small undulations or angles along the courses of the latter.

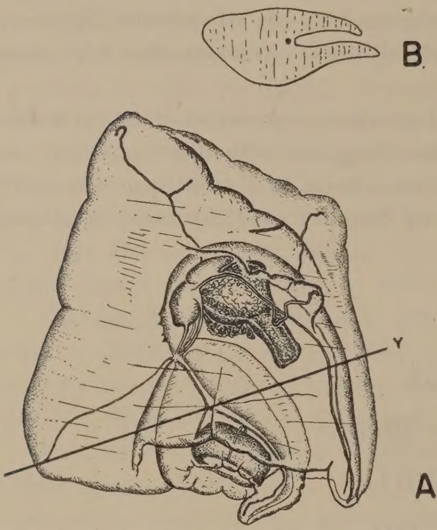

Fig. 3. *Nectopyramis thetis*; eudoxid, 9 mm high, "Thor" St. 76. A. Lateral view. B. Cross section of nectophore along the line XY in A.

Unfortunately, the present example adds nothing to our previously meagre knowledge of the appendages, for only the base of the stem, with fragments of young siphons, is present. The type specimen showed gonophores and young bracts, while Leloup (1932, 1933) has described free eudoxids probably belonging to this species.

Eudoxid of *N. thetis* (?). Leloup (1932 a) was the first to describe an eudoxid, referable to *N. thetis* because its canal system resembled that of a bract of the latter figured by Bigelow (1911 a, Pl. 28, Fig. 3—4) from the "Research" collection, and because it had a special nectophore similar, in general conformation, to the stem groups of the latter. The Monaco collection contained 6 more specimens (Leloup, 1933), which being in better condition, allowed him to amplify his original account. And the "Thor" series yields still another, which agrees with Leloup's account in all its essential features, though differing slightly in the shape of the bract and of the special nectophore.

In Leloup's specimens, the bract was definitely triangular with rounded margins (Leloup, 1932 a, Fig. 1—2; 1933, Pl. 1, Fig. 12). In the "Thor" specimen (Fig. 3), it is laterally much compressed, irregularly pentagonal, with five rounded angles corresponding to the terminations of the descending, ascending, and transverse canals, and to the postero-dorsal margin of the hydroecium[1]. Furthermore, the bract is spirally twisted (Fig. 4) so that the hydroecial opening is diverted somewhat to the left (Fig. 3) and is distinctly asymmetrical (Fig. 4) with the angle corresponding to the left-hand transverse canal lying at a level considerably below (basal) that of the right-hand side.

Were such differences as these to be found in the case of definitive nectophores, the latter would unhesitatingly be referred to different species. But in bracts, such divergences might represent successive stages in growth, during the period after their detachment, or they might very well result from different degrees of compression by neighboring bracts while still attached to the stem, or from different contraction phases. Since all of the specimens, Leloup's and the "Thor" alike, have been more or less distorted by preservation, the latter appears to be the correct explanation in the present case. This is the more likely since Leloup's original specimen corresponds to the "Thor" example in that the gelatinous wall of the bract is much thinner on the posterior side than on the anterior, whereas in his most recent figure (1933, Pl. 1, Fig. 12), these two walls are more nearly equal in thickness.

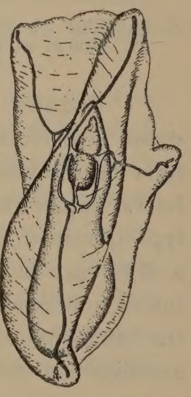

Fig. 4. *Nectopyramis thetis*; Antero-dorsal view of bract of specimen illustrated in Fig. 3.

The present specimen agrees so closely in all other essential characters with Leloup's (1933, p. 12) detailed account, that brief further mention will suffice here. Its most characteristic feature, and one in which this eudoxid differs from all others so far described, is that the pedicular plate, from which the siphon, tentacle, gonophores and the somatic canal system arise, is expanded into a bilobed vesicle (Figs. 3, 4, 5), named by Leloup (1933, p. 13), a "formation spéciale". Some distance basad, from the latter, but connected with it by 3 short canals, the special nectophore is attached to the wall of the hydroecium (Fig. 3). The characteristic and complex interrelationship of the somatic canals

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[1] Orientation deduced from young bract earlier figured (Bigelow, 1911 a).

is essentially as recorded by LELOUP. From the point of attachment of the special nectophore, one branch runs directly to the antero-dorsal angle of the bract, while three branches (a median and 2 laterals) run toward its apex. The median member of this group shortly dilates to form the capacious vesicle, just mentioned, which in LELOUP's specimen was triangular, but which is rounded and equatorially constricted in the "Thor" example. Unfortunately, its apical segment is damaged and therefore its outlines as shown in Figures 3—5 are necessarily somewhat idealized. The two lateral members of the ascending trio of canals apparently coalesce with this dilation as shown in Fig. 4[1]. In LELOUP's specimens, these points of coalescence form the lateral angles of the triangular structure, but in the "Thor" specimen the points of union lie just below the level of the circumferential constriction.

From the points of union, on either side, a canal runs out, along the hydroecial wall, to the postero-dorsal angle of the bract. The left hand member of this pair gives off one transverse branch running to the gelatinous prominence on that side of the bract. The other member of the pair gives off two such branches, one of which follows a corresponding course, while the other (again branching en route) extends out to the apical corner (Fig. 3—5).

Special nectophore. The canal system, well described by LELOUP, agrees closely to that of the corresponding nectophore in *Archisoma*, in that the main trunk extends from the point of pedicular attachment obliquely along the hydroecial face of the nectophore to its ventro-basal angle. En route, it gives off 4 separate trunks, running, respectively, to the dorsal, ventral, and lateral faces of the nectosac (Fig. 5).

The general form of the nectophore, like the one shown by LELOUP (1933, Pl. 1, Fig. 12), is rounded-triangular, much compressed laterally, with its ventro-basal angle somewhat extended. The deep hydroecial groove along the ventral face is enclosed by two broad, but separate wings of which the right hand is considerably the wider (Fig. 3).

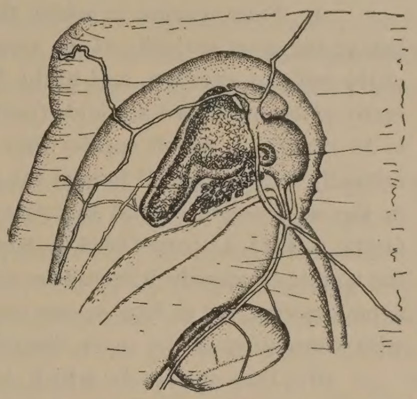

Fig. 5. *Nectopyramis thetis*; more enlarged view of siphon and canal system of specimen illustrated in Fig. 3, from the opposite side.

LELOUP's example bore both ♂ and ♀ gonophores, but the only trace of future sex-bells in the present specimen is one small bud (Fig. 5). The much contracted siphon presents nothing remarkable, and such tentilla as are still intact are very young.

## AMPHICARYONINAE Chun 1888.

## AMPHICARYON Chun 1888.

### AMPHICARYON ACAULE Chun 1888.

*Amphicaryon acaule*, Chun, 1888, p. 1162; Bigelow, 1911b, p. 195, Pl. 4, Figs. 1—8; 1918, p. 403; 1919, p. 332; 1931, p. 530; Moser, 1925, p. 399; Browne, 1926, p. 60; Totton, 1932, p. 330; Leloup, 1933, p. 9.

Material.

St. 69. 36°13′ N., 9°44′ W. 28. II. 1909.
Y. 300 m w. 1 col.
St. 91. 35°55′ N., 7°26′ W. 18. VI. 1910.
Y. 1600 m w. 1 col.
St. 96. 35°48′ N., 5°58′ W. 23. VI. 1910.
Y. 65 m w. 9 sup. nectoph., 6 inf. nectoph.
St. 282. 38°12′ N., 15°37′ E. 8. III. 1911.
S. 40 m w. 1 col.

These rather fragmentary specimens throw no light on the interesting question, whether the small degenerate nectophore of *Amphicaryon* is the older (superior) member of the pair (BIGELOW, 1911b, p. 196), or whether it is the younger (inferior), as MOSER (1925) argues[2]; nor do they add to the knowledge of the cormidia.

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[1] LELOUP so describes them, and so far as can be seen from surface views, this is the case in the present example.

[2] This latter view is tentatively accepted by TOTTON (1932, p. 330).

The series (all more or less damaged) add cumulative evidence, that the stem is here reduced to a plate-like structure, which is not extensible, and to which the individual groups of cormidia are attached close together. More detailed knowledge in this respect must await the study of living specimens. One of the specimens does, however, show several, of the tentilla which have not been described previously. These closely resemble HAECKEL's (1888b, Pl. 28, Fig. 8) illustration of the tentilla of *Mitrophyes peltifera*.

## **PRAYINAE** Haeckel 1888.

If we omit such of the older names as were based on descriptions, and illustrations, so inadequate that it is not possible to refer them to actual animals, all the representatives of this group so far described probably fall in seven species, at most, which may be grouped as follows:—

A. Four species, in which the subumbral canals as well as the somatocyst are simple. To this group belong the great majority of the accounts of Prayinae that have yet appeared. Owing to the extreme fragility of the bells in question, and to the fact that the species closely resemble one another in general appearance, many of the published accounts (particularly the earlier ones) are, however, so inadequate that it is impossible to be certain to which species they actually belonged. And as no recent student has had the opportunity critically to compare all four of the supposed species, it is not surprising that there has been great confusion in the nomenclature; and that the specific delimitations still await a satisfactory analysis, though MOSER (1925, p. 371), LELOUP (1934, p. 9) and BIGELOW (1911b, 1931) have already attempted somewhat to unravel the tangle. Obviously it would be most desirable to connect all of the older accounts (prior to 1850) with actual species, for as long as any one of them remains as a *nomen nudem*, it may be resurrected at any time, with consequences the more disturbing, the longer the event be postponed.

B. Two species in which both somatic and subumbral canals are branched. The first described, *Diphyes dubia* Quoy & Gaimard (1834), is the type of BLAINVILLE's (1834) genus *Praya*, as pointed out elsewhere (BIGELOW, 1931, p. 529[1]). A second species of this group was described by BIGELOW (1911b, p. 206, Pl. 1, Fig. 7, 8; Pl. 3, Fig. 1—7) as *Nectodroma reticulata*, but must be referred to *Praya*.

C. One species has been described with branched subumbral, but simple somatocyst canals, *Rosacea intermedia*, Leloup (1934, p. 11, Fig. 4).

Group A. As far as we have been able to learn, the first report of any prayid was the illustration, by DELLE CHIAJE (1822, Pl. 76, Fig. 1; republished in 1842, Pl. 33, Fig. 1) of his *Physalia cymbiformis*, which was next reported by QUOY & GAIMARD, (1834, p. 106, Pl. 5, Fig. 37, 38) as *Diphyes prayensis*. This species has subsequently been re-described and re-figured by many authors (see synonymy, p. 10, *Rosacea cymbiformis*). It is, in fact, the best known member of its family, hence it is a happy circumstance that QUOY & GAIMARD's illustrations of it were so diagnostic, that no serious doubt can be raised as to their identity, for they show the long hydroecium, long somatocyst and long nectophore with short nectosac.

Unfortunately this does not apply to the prayids next described, the *Rosacea ceutensis* and *R. plicata* of QUOY & GAIMARD (1827, p. 176, Pl. 4B, Fig. 2, 3 and p. 177, Pl. 4B, Fig. 4). The first of these has, by common consent, been relegated to the "doubtful" category, because no prayid bell has since been seen corresponding to it. And MOSER (1925, p. 373) disposes similarly of *plicata*. True, the figures of the latter are sketchy. They fail, for instance, to give any indication of the outlines of the hydroecial furrow, which has since proved to be specifically diagnostic in this subfamily. However, they do agree in two minor characters with the form later described by KÖLLIKER (1853) and by VOGT (1854) as *Praya diphyes*, and which subsequent investigations have proven a well-defined species (p. 11), namely, in the form of the nectophore, and of the apical termination of the somatocyst. TOTTON (1932, p. 329), LELOUP (1933, p. 8; 1934, p. 11), and BIGELOW (1911b, p. 201; 1913, p. 64) have followed SCHNEIDER (1898, p. 79) in referring *diphyes* to the synonymy of *plicata*. This course not only has the advantage of definitely establishing one of the oldest siphonophore names, but also of establishing the status of the old genus *Rosacea*, of which *plicata* has repeatedly been selected (by implication) as the type. *Plicata*, like *cymbiformis*, has now been examined so often that the most diagnostic specific features of its nectophores seem sufficiently established (p. 11). Moser (1923, p. 40; 1925, p. 506), it is true, believes that superior bells of the type here named *plicata* are merely persistent larval bells of *cymbiformis*. But the fact that in the latter, as pictured by her (1923, Pl. 1, Fig. 1, 3), the somatocyst lacks a descending branch and the subumbral canals are direct, forbids this possibility. The third species of this group, now generally recognized, is the *Praya medusa* of Metschnikoff (1870, p. 925, Pl. 1). This species had already been described, ten years earlier as *P. diphyes* by Graeffe (1860, p. 11, Pl. 1, Fig. 1—3), he not realizing that it was specifically distinct from Kölliker's species of that name (= *plicata*, see above). *Medusa* has subsequently been re-figured twice (Bedot, 1896, p. 369, Pl. 12, Fig. 1, *Lilyopsis rosacea*; Fewkes, 1880, Pl. 3, Fig. 2, *Praya* sp.?). Moser (1925, p. 506) also gives a recent description (as *Lilyopsis diphyes*). And the "Albatross" Eastern Pacific collection contained one fragmentary colony (Bigelow, 1911 b, p. 203). But it has so seldom been seen that its specific limits still remain somewhat doubtful. Moser, finally (1925, p. 379, Pl. 27, Fig. 1—5), has described a fourth member of this group as *Praya tuberculata*.

Group B. The first member of this group, to appear in literature, was the *Diphyes dubia* of Quoy & Gaimard (1834, p. 104, Pl. 5, Fig. 34—36). This was not seen again until Moser (1925, p. 381) and Bigelow (1911 b, p. 204, Pl. 3, Fig. 8, 9) found it, in collections from the Eastern Pacific. The "Arcturus" also obtained it in 1925 between the Galapagos Islands and the American coast (Bigelow, 1931, p. 531). Having so long dropped out of sight, it is fortunate that the original pictures of *dubia* were so good that there can be no doubt of their identity. The "Albatross" collection also yielded a second, and new member of this group, in which the subumbral canals form an anastomosing network (*Nectodroma reticulata*, Bigelow, 1911 b, p. 206, Pl. 1, Fig. 7, 8, Pl. 3, Fig. 1—7). *Reticulata* has subsequently been reported from the Eastern Sea between Japan and China, and from California (Bigelow, 1913, p. 65; 1931, p. 532: Bigelow and Leslie, 1930, p. 551).

Group C. The only known member of Group C is *Rosacea* (*Prayoides*) *intermedia*, recently described by Leloup (1934, p. 11, Fig. 4).

Much confusion has existed, as to how many genera the members of these groups represent, and as to what names should be used for the genera, the tendency having been toward a reduction of these. In revising the group in 1911, Bigelow recognized three; *Praya* with simple subumbral canals and somatocyst, and lacking special nectophores in the stem-groups, *Rosacea* separated from it only by the possession of special nectophores, and a new genus (*Nectodroma*) for species with branching canals and somatocyst. Moser (1925), the next reviser, united the first two, not considering the presence or absence of special nectophores a differential character of more than specific significance. This union is followed in the present paper. She also pointed out, that to accord with the rules of nomenclature, it would be necessary to transfer the name *Praya* to the species with branched canals, and to find some other name for those with simple canals, though to avoid confusion, she did not do so. And shortly after, this change was made by Bigelow (1931, p. 530). Most recently of all, Leloup's (1934, p. 11) discovery of a new species (*intermedia*) bridging the gap between prayids with branched, and those with simple canals and somatocyst, in that it has branched subumbral canals combined with a simple somatocyst, has prompted him to unite all known Prayinae in one genus, *Rosacea*[1].

Pending further information concerning *intermedia*, it seems to us wiser to retain the generic name *Praya* for species with branched subumbral canals, to emphasize the fact that two categories of species exist.

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[1] *Rosacea* dates from 1827; *Praya* from 1834: see above.

## ROSACEA Quoy and Gaimard 1827.

### ROSACEA CYMBIFORMIS, Delle Chiaje 1822.

Figs. 6—8.

*Physalia cymbiformis*, Delle Chiaje, 1822, Pl. 76, Fig. 1.

*Rosacea cymbiformis* Schneider, 1898, p. 79.

For further synonymy, see *Praya cymbiformis*, Bigelow, 1911 b, p. 200; Moser, 1925, p. 374; *Rosacea cymbiformis*, Leloup, 1933, p. 8.

#### Material.

St. 69. 36°13′ N., 9°44′ W. 28. II. 1909.
Y. 300 m w. 2 nectoph.
St. 71. 39°35′ N., 9°45′ W. 4. III. 1909.
Y. 600 m w. 2 nectoph.
St. 106. 36°33′ N., 2°00′ W. 25. VI. 1910.
Y. 300 m w. 4 nectoph.
St. 108. 36°03′ N., 0°27′ W. 25. VI. 1910.
Y. 65 m w. 4 nectoph.
St. 112. 36°56′ N., 2°15′ E. 27. VI. 1910.
Y. 300 m w. 10 nectoph.
St. 115. 38°17′ N., 4°11′ E. 28. VI. 1910.
Y. 300 m w. 1 nectoph.
St. 183. 37°52′ N., 23°09′ E. 16. VIII. 1910.
Y. 300 m w. 30 nectoph. (fragm.).
St. 217. 38°01′ N., 1°48′ E. 1. IX. 1910.
Y. 300 m w. 1 nectoph.
St. 223. 36°13′ N., 1°28′ W. 5. IX. 1910.
Y. 300 m w. 1 nectoph.
St. 232. 36°28′ N., 9°06′ W. 9. IX. 1910.
Y. 1000 m w. 2 nectoph.
St. 233. 36°49′ N., 9°15′ W. 10. IX. 1910.
Y. 25 m w. 38 nectoph.

The nectophores of *R. cymbiformis* are so fragile that when found among gatherings of plankton they are usually in a very fragmentary condition, and the "Thor" series is no exception to this rule. Fortunately, however, the most distinctive morphological character of the species is usually recognizable in fragmentary nectophores, namely, that the hydroecial groove extends past the nectosac, right to the base of the bell, as does the descending branch of the somatocyst also. Bells of *R. cymbiformis* (Figs. 6—8) strongly contrast in this respect, with those of *R. plicata* (p. 11) and it is on this basis that the bells listed above have been identified. In all of them, the whole stem has been lost, so that they add nothing morphologically, to previous accounts.

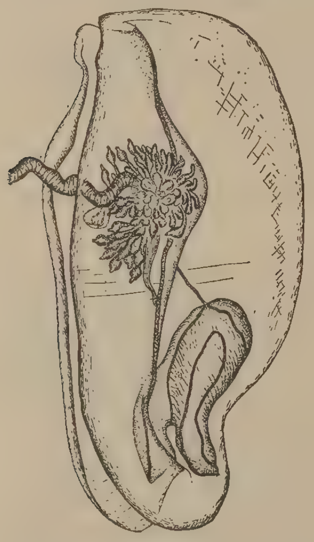

Fig. 6. *Rosacea cymbiformis*; lateral view of nectophore of 30 mm. from "Atlantis" St. 1735.

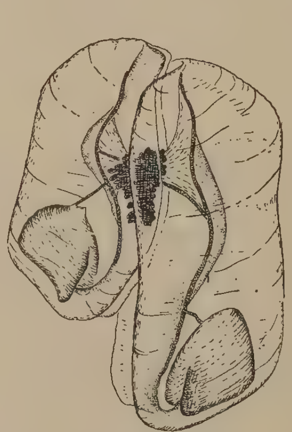

Fig. 7. *Rosacea cymbiformis*; pair of nectophores, 31 mm. and 23 mm., still connected, from Naples Zoological Station (Mus. Comp. Zoöl. Cat. No. 898).

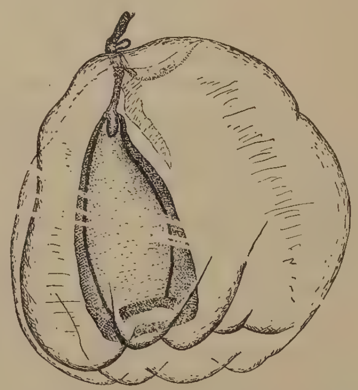

Fig. 8. *Rosacea cymbiformis*; gonophore, about 1.9 mm. high from a specimen from "Atlantis" St. 1735, X 27.

## **ROSACEA PLICATA** Quoy and Gaimard 1827.

Figs. 9—14.

*Rosacea plicata*, Quoy and Gaimard, 1827, p. 177, Pl. 4B, Fig. 4. For synonymy, see *Rosacea plicata*, Bigelow, 1911b, p. 201; Leloup, 1933, p. 8; and *Praya diphyes*, Moser, 1925, p. 377.

### Material.

St. 69. 36°13′ N., 9°44′ W. 28. II. 1909.
Y. 600 m w. 9 loose nectoph.; 5—21 mm. high.

St. 234. 38°10′ N., 9°20′ W. 10. IX. 1910.
Y. 1000 m w. 4 nectoph.

Specific identification of these bells rests on the great depth and shortness of the hydroecial furrow, and on the shortness of the descending branch of the somatocyst, which terminates above the aboral level of the nectosac. In these features they agree closely with specimens already described from the Bay of Biscay (Bigelow, 1911a, p. 341); from the Eastern Tropical and Northeastern Pacific (Bigelow 1911b, p. 201; 1913, p. 64); and differ markedly from the nectophores of *R. cymbiformis* (p. 10, Fig. 6—8).

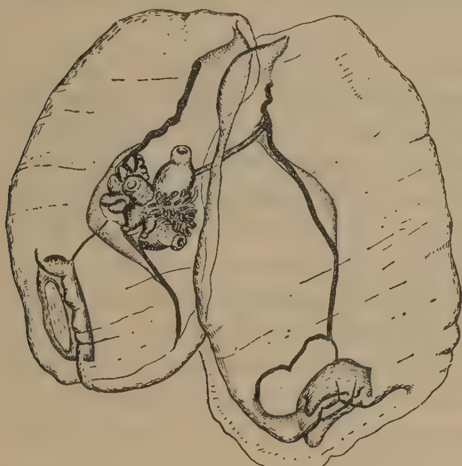

Fig. 9. *Rosacea plicata*; pair of nectophores, 16 mm. and 13 mm., still connected, from Bering Sea, "Albatross" St. 4767[1].

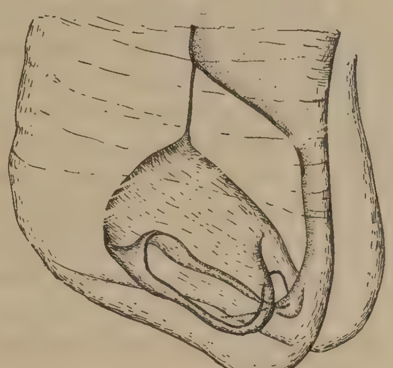

Fig. 10. *Rosacea plicata*; lateral view of basal portion of loose inferior nectophore, 20 mm. long, from Bering Sea, "Albatross" St. 4763.

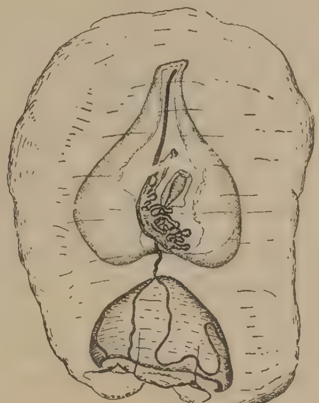

Fig. 11. *Rosacea plicata*; dorsal view of nectophore, 21 mm. long, from "Thor" St. 69.

One of us has previously commented on the fact that the inferior (older) nectophore of the pair, in *plicata*, so closely resembles that of *cymbiformis*, that "the two might be easily confused in the absence of their respective superior nectophores" (Bigelow 1911a, p. 343), or are actually indistinguishable (Bigelow 1913, p. 65). It seems, however, that the location of the point of attachment of the pedicular canal is diagnostic for the inferior (older) nectophore, for in a specimen from Bering Sea[1] (Fig. 9) this is situated relatively much closer to the apex of the bell, (i. e. relatively farther away from the point of origin of the canal that runs to the nectosac) than it is in two excellent specimens of *cymbiformis* from Naples (Fig. 7), in another of that species from the Eastern Tropical Pacific (Bigelow, 1911b, Pl. 2, Fig. 1) or than it is shown by Haeckel (1888b, Pl. 31, Fig. 6). In the superior (younger) nectophores, however, the attachment of the pedicular canal is only slightly above the origin of the subumbral.

Conclusive evidence would be welcome, as to whether *R. plicata* actually does develop a permanently sterile swimming bell in each of the cormidia, as do certain of the diphyids, or whether the structures so interpreted by Kölliker[1] (1853a) and by Vogt (1854) were in reality gonophores that had lost the spadix, such as Keferstein & Ehlers (1861, Pl. 5, Fig. 10) observed and illustrated.

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[1] This is one of the specimens reported earlier by Bigelow (1913, p. 64). The relative positions of the 2 bells were found to be reversed (i. e. the apex end of the smaller bell lay opposed to the basal part of the larger). Before the illustration (Fig. 9) was drawn they were twisted back into what almost certainly seems to have been their natural relationship.

As elsewhere pointed out (Bigelow, 1911a, p. 342, 1913, p. 65), one specimen in the "Research" collection bore what appeared to be a typical sterile nectophore, in addition to gonophores. And the contracted base of the stem in one "Thor" specimen (Fig. 11) bears a similar small empty bell, in addition to young siphons and buds. But that such structures are simply gonophores which have lost the spadix is made highly probable by the fact that a ♂ gonophore, in one of the "Research" series, from which the spadix was accidentally detached while we were drawing figures 12 and 14, thereafter had precisely the same appearance as the apparently sterile bell in the "Thor" specimen (Fig. 11). We might call attention, in particular to the fact that the spadix came out "clean", so that the bell after losing it shows no apparent sign that it had previously contained one.

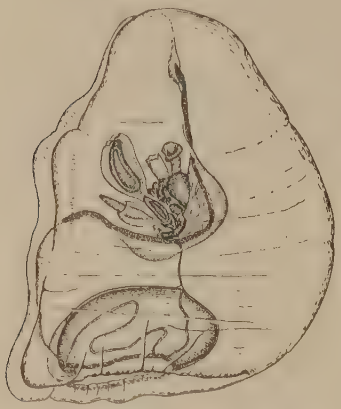
Fig. 12. *Rosacea plicata*; lateral view of nectophore, 18 mm. long, collected in the Bay of Biscay by H. M. S. "Research" (Mus. Comp. Zool. Cat. No. 804).

Present indications, then, are that the so-called "special swimming bells" of *R. plicata* are actually the old gonophores, from which the spadix has become detached after the discharge of the sex products, and that these empty bells continue attached to the stem for some time thereafter, serving as swimming organs. But the question cannot be considered as settled until some student has opportunity to examine a specimen with a considerable length of stem intact, with several groups of appendages.

The sterile (or empty) bell in the "Thor" specimen (Fig. 11) is laterally flattened. But judging from its present appearance this is at least partly due to general flattening in preservation. The larger of the two gonophores in the "Research" specimen, shown in Fig. 14, is distinctly ovate, its gelatinous wall thickened along the side which, in side view, shows an apical expansion. And Vogt (1852, Pl. 14, Fig. 3; 1854, Pl. 17, Fig. 1) shows

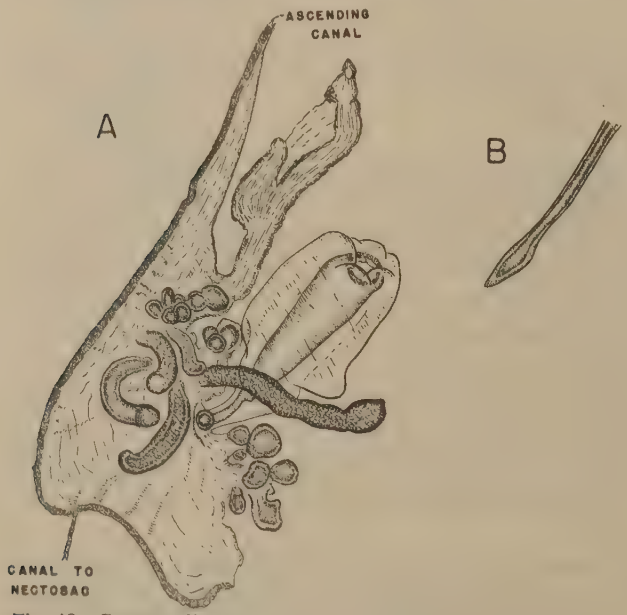

Fig. 13. *Rosacea plicata*; A. Appendages of specimen from "Thor" St. 69, same view as Fig. 11. × 25. B. Apex of somatocyst from another specimen. × 25.

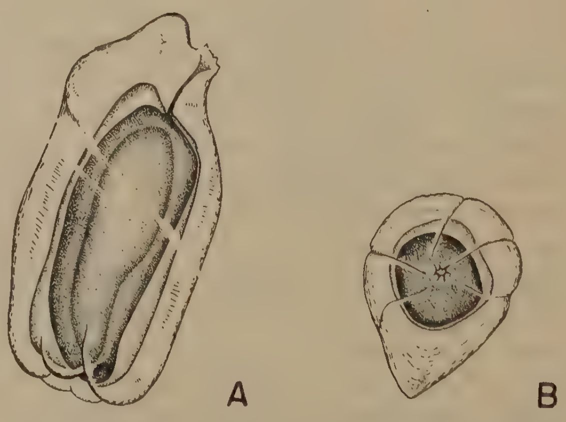

Fig. 14. *Rosacea plicata*; ♂ gonophore, 4 mm. high, with spadix detached, from specimen shown in Fig. 12. A. Lateral view; B. Oral view.

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[1] Bigelow's (1913, p. 64) statement that nothing of the sort was shown by Kölliker was incorrect, for he described and figured a "kleine Schwimmglocke" (Kölliker 1853a, p. 36, Pl. 9, Fig. 2).

a still more pronounced wing-like asymmetrical expansion. But Kölliker (1853a, Pl. 9, Fig. 2) does not show this asymmetry, and Keferstein & Ehlers (1861, p. 22) expressly remark that the sex bells have no angles, as is the case in *R. cymbiformis* (Fig. 8). Probably the correct interpretation for these different accounts is that the sex bells may either be circular in cross-section, or more or less flattened and more or less asymmetrical, depending on the degree to which they are crowded by neighboring siphons, or bells, during their period of most active growth.

Another feature in which previous accounts have varied is the conformation of the extremity of the somatocyst, whether or not it is dilated. The present series confirms our earlier (Bigelow 1913) explanation that this is not of taxonomic significance, but represents either different contraction phases, or individual variation.

### **PRAYINAE** genus?

Material.

St. 29. 40°47′ N., 12°55′ E. 20. I. 1909.
Y. 1650 m w. 1 nectoph.
St. 46. 37°17′ N., 6°00′ E. 7. II. 1909.
Y. 300 m w. 1 nectoph.
St. 51. 36°27′ N., 0°37′ W. 18. II. 1909.
Y. 300 m w. Fragments.
St. 69. 36°13′ N., 9°44′ W. 28. II. 1909.
Y. 300 m w. Nectoph.
C. 3000 m w. Bracts.
St. 74. 44°21′ N., 7°55′ W. 8. III. 1909.
Y. 600 m w. 2 nectoph.
St. 99. 36°02′ N., 5°16′ W. 23. VI. 1910.
Y. 300 m w. 1 nectoph.
St. 107. 36°18′ N., 1°14′ W. 25. VI. 1910.
Y. 2000 m w. Fragments.
St. 113. 36°53′ N., 3°09′ E. 28. VI. 1910.
Y. 300 m w. Fragments.
St. 232. 36°28′ N., 9°06′ W. 9. IX. 1910.
Y. 300 m w. Fragments.

Bells listed above are so fragmentary that it is not possible to identify them.

The bracts from Station 69 are, however, in tolerably good condition. Their general conformation, and arrangement of canals, suggest that they are Prayinae. But they cannot be referred to any species.

## HIPPOPODIIDAE Kölliker 1853.

Although the character (form of the nectophores) on which generic separation in this family has usually been based, has been shown by Moser (1925) to be too trivial for more than specific significance, one of us has elsewhere argued (Bigelow, 1931, p. 536) that differences in the structure of the tentilla demand the retention of *Vogtia* as distinct from *Hippopodius*. On this basis, the two known genera of Hippopodiidae, may be defined as follows:—

Cnidoband "sac-like" from the beginning ........................................ *Hippopodius*
Cnidoband at first spirally coiled, though with the coil finally coming to lie in one plane, thus secondarily assuming a sac-like outline ........................................ *Vogtia*

*Vogtia*, as above defined, includes all three of the angular-belled hippopodids, the spiral coiling of the cnidoband having been described for *V. serrata* by Moser (1925)[1], for *V. pentacantha* by Keferstein and Ehlers (1861, p. 24, Pl. 3, Fig. 13—16), for *V. spinosa* by Bigelow (1911b, Pl. 15, Fig. 6, 7), and for the rounded-belled form, *V. glabra* by Bigelow (1918, p. 408, Pl. 4, Fig. 6, 7).

Admittedly, this scheme has a practical drawback. Should loose bells of some new hippopodid be taken, it would be impossible to refer them to their correct genus in the absence of the tentilla.

## HIPPOPODIUS Quoy and Gaimard 1827.

As limited above *Hippopodius* includes only one known species.

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[1] Moser (1925, p. 422, Pl. 27, Fig. 6) mentions "korkzieherartig aufgerollten Nesselknöpfen" and also indicates them on her illustration of the colony.

## HIPPOPODIUS HIPPOPUS Forskål 1776.

Fig. 15—19.

*Gleba Hippopus*, Forskål, 1776, p. 14, Pl. 43, Fig. E. For synonymy, see Bigelow, 1911 b, p. 208; 1931, p. 536; Moser, 1925, p. 409 (*Hippopodius luteus*); Leloup, 1933, p. 15.

### Material.

St. 10. 37°21′ N., 16°45′ E. 15. XII. 1908.
Y. 25 m w. 50 nectoph.
Y. 65 m w. 62 nectoph.
Y. 300 m w. 7 nectoph.
Y. 600 m w. 8 nectoph.
St. 11 36°57′ N., 18°16′ E. 16. XII. 1908.
Y. 25 m w. 108 nectoph.
Y. 300 m w. 5 nectoph.
St. 20. 37°48′ N., 15°49′ E. 5. I. 1909.
Y. 25 m w. 5 nectoph.
St. 24. 40°14′ N., 12°23′ E. 16. I. 1909.
Y. 65 m w. 1 nectoph.
Y. 300 m w. 3 nectoph.
Y. 600 m w. 4 nectoph.
St. 25. 40°34′ N., 13°24′ E. 17. I. 1909.
Y. 65 m wire. 20 nectoph.
St. 26. 40°40′ N., 13°59′ E. 19. I. 1909.
Y. 300 m w. 68 nectoph.
St. 28. 40°53′ N., 13°43′ E. 19. I. 1909.
Y. 25 m wire. 1 nectoph.
St. 29. 40°47′ N., 12°55′ E. 20. I. 1909.
Y. 200 m w. 27 nectoph.
St. 30. 41°15′ N., 11°55′ E. 21. I. 1909.
Y. 65 m w. 7 nectoph.
Y. 300 m w. 1 nectoph.
St. 31. 41°44′ N., 10°52′ E. 21. I. 1909.
Y. 65 m w. 9 nectoph.
Y. 200 m w. 4 nectoph.
Y. 600 m w. 1 nectoph.
St. 33. 43°04′ N., 9°35′ E. 22. I. 1909.
Y. 65 m w. 4 nectoph.
St. 34. 43°27′ N., 8°16′ E. 23. I. 1909.
Y. 65 m w. Nectoph.
St. 35. 43°36′ N., 7°36′ E. 28. I. 1909.
Y. 300 m w. 43 nectoph.
Y. 1000 m w. 11 nectoph.
C. 2500 m w. 5 nectoph.
St. 36. 42°49′ N., 6°54′ E. 30. I. 1909.
Y. 65 m w. 21 nectoph.
Y. 300 m w. 8 nectoph.
St. 38. 40°45′ N., 9°50′ E. 31. I. 1909.
Y. 65 m w. 7 nectoph.
St. 39. 39°41′ N., 10°02′ E. 1. II. 1909.
Y. 25 m w. 19 nectoph.
Y. 65 m w. 14 nectoph.
Y. 300 m w. 1 nectoph.
St. 40. 39°10′ N., 9°40′ E. 1. II. 1909.
Y. 65 m w. 19 nectoph.
St. 42. 38°58′ N., 9°37′ E. 2. II. 1909.
Y. 300 m w. 25 nectoph.
St. 43. 38°14′ N., 8°42′ E. 3. II. 1909.
Y. 65 m w. 37 nectoph.
St. 46. 37°17′ N., 6°00′ E. 7. II. 1909.
Y. 600 m w. 14 nectoph.
St. 47. 36°55′ N., 3°12′ E. 8. II. 1909.
Y. 65 m w. 10 nectoph.
Y. 300 m w. 22 nectoph.
St. 50. 37°02′ N., 1°17′ E. 16. II. 1909.
Y. 25 m w. 14 nectoph.
Y. 1600 m w. 1 nectoph.
St. 51. 36°27′ N., 0°37′ W. 18. II. 1909.
Y. 300 m w. 16 nectoph.
St. 55. 36°46′ N., 2°18′ W. 19. II. 1909.
Y. 65 m w. 90 nectoph.
St. 57. 36°40′ N., 3°30′ W. 20. II. 1909.
Y. 25 m w. 4 nectoph.
Y. 200 m w. 13 nectoph.
St. 58. 36°36′ N., 4°24′ W. 20. II. 1909.
Y. 65 m w. 1 nectoph.
St. 59. 36°02′ N., 4°24′ W. 20. II. 1909.
Y. 25 m w. 1 nectoph.
Y. 500 m w. 1 nectoph.
St. 65. 35°53′ N., 7°26′ W. 24. II. 1909.
Y. 65 m w. 3 nectoph.
Y. 300 m w. 33 nectoph.
Y. 600 m w. 5 nectoph.
St. 69. 36°13′ N., 9°44′ W. 28. II. 1909.
Y. 25 m w. 2 nectoph.
Y. 300 m w. 17 nectoph.
St. 74. 44°21′ N., 7°55′ W. 9. III. 1909.
Y. 600 m w. 1 nectoph.
St. 89. 36°28′ N., 8°22′ W. 18. VI. 1910.
Y. 300 m w. 9 nectoph.
Y. 1000 m w. 1 nectoph.
St. 91. 35°53′ N., 7°26′ W. 18. VI. 1910.
Y. 1600 m w. 12 nectoph.
St. 95. 37°57′ N., 6°00′ W. 23. VI. 1910.
Y. 65 m w. 1 nectoph.
Y. 300 m w. 14 nectoph.
St. 96. 35°48′ N., 5°58′ W. 23. VI. 1910.
Y. 65 m w. 5 nectoph.
St. 99. 36°02′ N., 5°16′ W. 23. VI. 1910.
Y. 65 m wire. 3 nectoph.
Y. 300 m w. 9 nectoph.
St. 106. 36°33′ N., 2°00′ W. 25. VI. 1910.
Y. 300 m w. 5 nectoph.
Y. 1200 m w. 5 nectoph.
St. 107. 36°18′ N., 1°14′ W. 25. VI. 1910.
Y. 2000 m w. 1 nectoph.
St. 108. 36°03′ N., 0°27′ W. 25. VI. 1910.
Y. 300 m w. 6 nectoph.
St. 113. 36°53′ N., 3°09′ E. 28. VI. 1910.
Y. 300 m w. 2 nectoph.
St. 115. 38°17′ N., 4°11′ E. 28. VI. 1910.
Y. 25 m w. 3 nectoph.
Y. 65 m w. 5 nectoph.
St. 116. 39°27′ N., 5°26′ E. 29. VI. 1910.
Y. 25 m w. 11 nectoph.
St. 123. 44°14′ N., 8°55′ E. 2. VII. 1910.
Y. 65 m w. 4 nectoph.
Y. 300 m w. 5 nectoph.
St. 124. 44°20′ N., 9°05′ E. 3. VII. 1910.
Y. 65 m w. 5 nectoph.
St. 125. 43°54′ N., 9°13′ E. 9. VII. 1910.
Y. 25 m w. 1 nectoph.
St. 130. 39°35′ N., 11°20′ E. 13. VII. 1910.
Y. 25 m w. 1 nectophore.
St. 131. 38°36′ N., 11°00′ E. 13. VII. 1910.
Y. 25 m w. 1 nectoph.
Y. 300 m w. 10 nectoph.
St. 132. 38°57′ N., 9°47′ E. 14. VII. 1910.
Y. 25 m w. Nectoph.
Y. 300 m w. 8 nectoph.
St. 133. 38°18′ N., 9°59′ E. 14. VII. 1910.
Y. 25 m w. 2 nectoph.
Y. 300 m w. 7 nectoph.
St. 134. 37°37′ N., 10°17′ E. 15. VII. 1910.
Y. 25 m w. 17 nectoph.

St. 137. 37°17′ N., 10°56′ E. 19. VII. 1910.
Y. 250 m w. 4 nectoph.
St. 138. 37°37′ N., 11°25′ E. 19. VII. 1910.
Y. 1000 m w. 2 nectoph.
St. 139. 37°57′ N., 11°54′ E. 20. VII. 1910.
Y. 300 m w. 7 nectoph.
Y. 800 m w. 1 nectoph.
St. 143. 35°18′ N., 16°25′ E. 22. VII. 1910.
Y. 25 m w. 7 nectoph.
Y. 1000 m w. 1 nectoph.
St. 144. 34°31′ N., 18°40′ E. 23. VII. 1910.
Y. 300 m w. 14 nectoph.
St. 145. 32°38′ N., 19°02′ E. 25. VII. 1910.
Y. 25 m w. 7 nectoph.
Y. 300 m w. 5 nectoph.
St. 147. 31°35′ N., 19°02′ E. 25. VII. 1910.
Y. 25 m w. 3 nectoph.
Y. 300 m w. 10 nectoph.
St. 154. 32°10′ N., 24°46′ E. 29. VII. 1910.
Y. 300 m w. 7 nectoph.
St. 156. 32°16′ N., 26°03′ E. 30. VII. 1910.
Y. 25 m w. 11 nectoph.
Y. 1000 m w. 12 nectoph.
St. 158. 34°23′ N., 27°57′ E. 31. VII. 1910.
Y. 300 m w. 24 nectoph.
St. 160. 35°59′ N., 28°14′ E. 1. VIII. 1910.
Y. 1000 m w. 7 nectoph.
Y. 4000 m w. 9 nectoph.
St. 163. 37°52′ N., 26°22′ E. 2. VIII. 1910.
Y. 200 m w. 20 ± nectoph.
St. 182. 38°18′ N., 24°48′ E. 14. VIII. 1910.
Y. 600 m w. 9 nectoph.
St. 183. 37°52′ N., 23°09′ E. 16. VIII. 1910.
Y. 65 m w. 6 nectoph.
St. 186. 37°57′ N., 19°51′ E. 17. VIII. 1910.
Y. 65 m w. 1 nectoph.
Y. 300 m w. 1 nectoph.
St. 187. 37°54′ N., 18°02′ E. 18. VIII. 1910.
Y. 25 m w. 2 nectoph.
Y. 300 m w. 6 nectoph.
Y. 1000 m w. 4 nectoph.
St. 189. 37°44′ N., 15°58′ E. 19. VIII. 1910.
Y. 25 m w. 1 nectoph.
St. 190. 37°51′ N., 15°19′ E. 19. VIII. 1910.
Y. 25 m w. 6 nectophores.
St. 192. 38°07′ N., 15°35′ E. 20. VIII. 1910.
Y. 25 m w. 3 nectoph.
Y. 600 m w. 1 nectoph.
St. 193. 38°15′ N., 15°39′ E. 21. VIII. 1910.
Y. 10 m w. 4 nectoph.
St. 194. 38°33′ N., 15°29′ E. 21. VIII. 1910.
Y. 10 m w. 6 nectoph.
Y. 25 m w. 11 nectoph.
Y. 1200 m w. 2 nectoph.
St. 195. 39°02′ N., 14°55′ E. 21. VIII. 1910.
Y. 25 m w. 13 nectoph.
St. 199. 39°32′ N., 10°49′ E. 25. VIII. 1910.
Y. 25 m w. 10 nectoph.
Y. 300 m w. 2 nectoph.
St. 200. 39°18′ N., 10°11′ E. 26. VIII. 1910.
Y. 25 m w. 7 nectoph.
St. 204. 38°52′ N., 7°43′ E. 27. VIII. 1910.
Y. 65 m w. 3 nectoph.
St. 205. 39°16′ N., 5°52′ E. 27. VIII. 1910.
Y. 25 m w. 16 nectoph.
St. 206. 39°32′ N., 5°15′ E. 28. VIII. 1910.
Y. 25 m w. 2 nectoph.
Y. 300 m w. 9 nectoph.
Y. 1000 m w. 5 nectoph.
Y. 2000 m w. 15 nectoph.
St. 209. 40°34′ N., 3°03′ E. 29. VIII. 1910.
C. 150 m w. 3 nectophores.
St. 210. 41°10′ N., 2°23′ E. 30. VIII. 1910.
Y. 25 m w. 2 nectoph.
Y. 600 m w. 12 nectoph.
St. 215. 39°14′ N., 0°52′ E. 31. VIII. 1910.
Y. 25 m w. 7 nectoph.
St. 216. 38°31′ N., 1°24′ E. 1. IX. 1910.
Y. 25 m wire. 11 nectoph.
St. 218. 36°54′ N., 2°57′ E. 2. IX. 1910.
Y. 25 m w. 61 nectoph.
St. 223. 36°13′ N., 1°28′ W. 5. IX. 1910.
Y. 25 m w. 3 nectoph.
St. 228. 36°02′ N., 5°06′ W. 7. IX. 1910.
Y. 300 m w. 4 nectoph.
St. 232. 36°28′ N., 9°06′ W. 9. IX. 1910.
Y. 25 m w. 1 nectophore.
St. 233. 36°49′ N., 9°15′ W. 10. IX. 1910.
Y. 25 m w. 3 nectoph.
St. 276. 36°30′ N., 19°20′ E. 4. IV. 1911.
S. 132 m w. 51 nectoph.
St. 277. 33°20′ N., 27°30′ E. 6. IV. 1911.
S. 132 m wire. 250 ± nectoph.
St. 279. 38°11.5 N., 15°36.5′ E. 23. II. 1911.
S. 30 m w. 4 nectoph.
St. 281. 38°15′ N., 15°37.5′ E. 1. III. 1911.
S. 30 m w. 1 nectoph.
St. 282. 38°12′ N., 15°37′ E. 8. III. 1911.
S. 40 m w. 7 nectoph.
St. 283. 38°12′ N., 15°37.5′ E. 12. III. 1911.
S. 40 m w. 7 nectoph.
St. 296. 32°10′ N., 29°50′ E. 25. VI. 1911.
S. 28 m w. 1 nectoph.
St. 297. 33°10′ N., 25°03′ E. 25. VI. 1911.
S. 28 m w. 190 ± nectoph.
St. 298. 34°20′ N., 21°10′ E. 26. VI. 1911.
S. 38 m w. 61 nectoph.
St. 339. 40°30′ N., 3°10′ E. 20. VIII. 1911.
S. 28 m wire. Nectoph.
St. 340. 35°50′ N., 21°30′ E. 26. VIII. 1911.
S. 28 m w. 3 nectoph.
St. 341. 34°00′ N., 26°20′ E. 27. VIII. 1911.
S. 28 m w. 14 nectoph.

The many descriptions of the general morphology of *Hippopodius hippopus*, and of its development, have paid little attention to the conformation of the nectophores, no doubt because there seemed to be no danger of confusing this species with any other known siphonophore. The recent discovery, however, of another hippopodid (*Vogtia glabra*, p. 17), the bells of which are likewise rounded, not angular, makes it desirable to illustrate those of *H. hippopus* here, especially as the identification of this species is often based on captures of loose bells in the tow-net.

The most distinctive feature, apart from the oft-quoted horse-shoe-like form, is the presence of four rounded dorsal knobs, arranged along an arc, close to, and paralleling the oral margin, on its apical side (Figs. 15, 16). These four knobs were first shown by Vogt (1854, Pl. 15, Fig. 2), and more recently by Lens and Van Riemsdijk (1908, Pl. 9, Fig. 80); Browne (1926, p. 61); Moser (1925, p. 410) and Totton (1932, p. 330).

So far, no variation in their number has been observed. The full number of knobs is discernable from the time the bell assumes its definitive form (Fig. 15). They are in fact much more prominent in small bells than in the large ones (cf. Fig. 15 with Fig. 18). In *Vogtia glabra*, on the contrary, the bells bear only two prominences and Totton (1932, p. 331) states that these two were to be seen in a *V. glabra* bell only 4 mm. long, but beginning to assume its definitive shape. Considerable variation is, however, to be seen among preserved specimens of *H. hippopus*, in the conformation of the basal part of the bell, especially in the relative spread between the basal corners. This is due probably to contraction, or perhaps in part to varying degrees of compression by the adjacent bells in the colony. For example, the basal angles of the medium sized bells of one colony[1] are drawn closely together (Fig. 16), whereas in a smaller bell they are spread wide apart (Fig. 15), while in two larger bells, presumably from the same colony (13 and 14 mm. long) the basal outline is much as illustrated in Fig. 17—18. The nectophore 19 mm. wide, illustrated in Fig. 17—19, is the largest yet definitely recorded. Previous authors have commented on such other diagnostic features as the shoalness of the nectosac and the opalescence and rigidity of the bell as a whole.

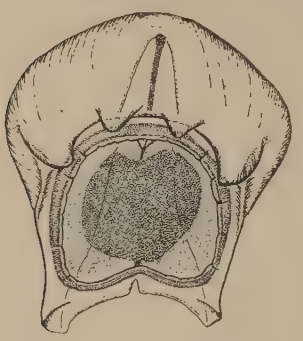

Fig. 15. *Hippopodius hippopus*; Dorsal view of the second nectophore, 8 mm. in length, from a colony from "Bache" St. 10180, in the Western Atlantic.

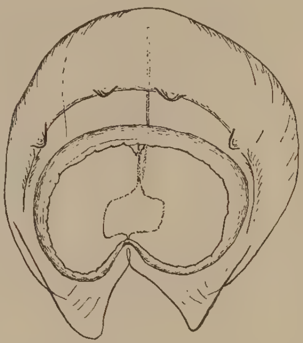

Fig. 16. *Hippopodius hippopus*; dorsal view of one of the medium sized nectophores, 10.5 mm. in length, from the same colony as the nectophore illustrated in Fig. 15.

We may add, since it has not previously been emphasized, that in *H. hippopus*, as in the various species of *Vogtia*, the ventral sinus decreases greatly in relative size with the growth of the nectophore. In none of the specimens examined, has it been possible to trace the union of the radial subumbral canals with the ring canal, because of strong contraction or fragmentary condition. Nor has this point been made clear in any of the earlier illustrations or accounts.

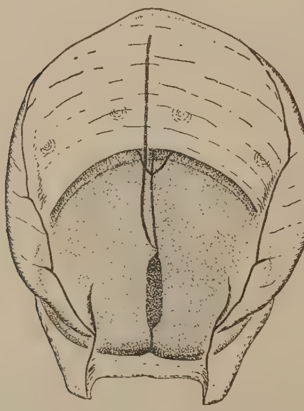

Fig. 17. *Hippopodius hippopus*; ventral view of seventh nectophore, 19 mm. long, from a colony from the Western Atlantic, "Arcturus" St. 18.

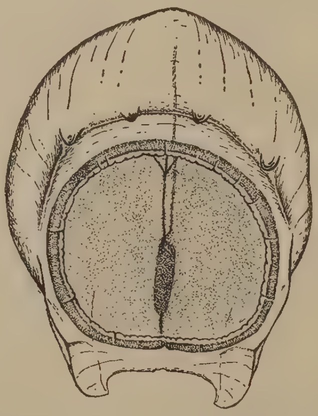

Fig. 18. *Hippopodius hippopus*; dorsal view of nectophore illustrated in Fig. 17.

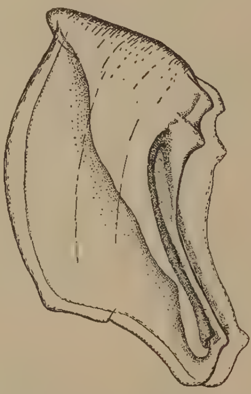

Fig. 19. *Hippopodius hippopus*; lateral view of nectophore illustrated in Fig. 17 and 18.

The features in which Haeckel's (1888b, Pl. 29, Fig. 1, 2, 4) illustrations of his *Polyphyes ungulata* differ from *H. hippopus* are the pointed, claw-like shape and large size of the four knobs, the sharply angular bell, and the angular-rhomboid form of the ventral sinus. Bearing in mind the extent to which Haeckel's beautiful pictures of siphonophores were idealized, we have no doubt that Moser (1925, p. 410) was correct in relegating *ungulata* definitely to the synonymy of *hippopus*.

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[1] Now detached, but two or three of the younger bells are still connected.

The "Thor" series contains only definitive bells. Probably the absence of larval nectophores is due to the coarseness of the mesh of the nets in which most of the plankton samples were collected.

## VOGTIA Kölliker 1853.

According to recent discussions (Bigelow, 1911b; 1918; Moser, 1925), the known members of *Vogtia*, as defined above, represent four species, the most obviously diagnostic features of their nectophores being as follows:—

1. Bell angular, pentagonal, prismatic in form.
   a. Facets as well as angles bear conical gelatinous prominences........................ *spinosa*
   b. Only the angles bear such prominences, the facets being smooth.................. *pentacantha*
   c. No conical prominences, the angles being merely finely serrate...................... *serrata*
2. Bell rounded.................................................................... *glabra*

The nectophores of the three angular-belled species differ so much in general aspect from those of all other known siphonophores that there is no danger of confusing them with any other genus. And if well preserved, the differences between them are so clear (the thorns are extremely arresting to the eye) that specific identification is easy. Unfortunately, however, the sculpturing of the facets and angles often loses definition, and even disappears altogether in loose bells, either from damage in the net, or in the process of disintegration while still afloat in the sea, making specific identification impossible. And the "Thor" collection contains a considerable number of such relics (p. 19).

The nectophores of the rounded-belled species, *glabra*, resemble those of *Hippopodius hippopus* more closely in general appearance, than they do those of the other *Vogtias*. But they are easily separated from *Hippopodius* if in good condition, by the fact they have only two prominences (*Hippopodius* has four) on the dorsal side, that the oral-aboral flattening of the nectosac is not so extreme, and that the apical outline is much more pointed (cf. Fig. 20 and Bigelow, 1918, Pl. 4, Fig. 2—5 with Figs. 15—19).

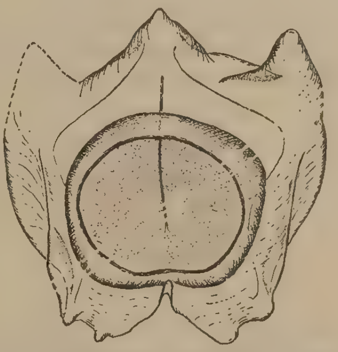

Fig. 20. *Vogtia glabra*; dorsal view of nectophore, 11 mm. in length from "Thor" St. 91.

### VOGTIA GLABRA Bigelow 1918.

Fig. 20.

*Vogtia glabra*, Bigelow, 1918, p. 407, Pl. 4, Fig. 2—7; Totton, 1932, p. 331.
*Hippopodius glabrus*, Leloup, 1933, p. 17; 1934, p. 6.

Material.

St. 69. 36°13′ N., 9°44′ W. 28. II. 1909.
  Y. 65 m w. 3 nectoph.
  Y. 300 m w. 40 nectoph.
St. 71. 39°35′ N., 9°45′ W. 4. III. 1909.
  Y. 1600 m w. 1 nectoph.
St. 91. 35°53′ N., 7°26′ W. 18. VI. 1910.
  1600 m w. 10 nectoph., 3 still connected (or 1 col.?).
St. 186. 37°57′ N., 19°51′ E. 17. VIII. 1910.
  Y. 1200 m w. 3 nectoph.

This list includes all hippopodid bells which are rounded in outline and show only two prominences on the dorsal side.

The catches all consist of loose bells in poor condition, except that from Station 91. The latter apparently represents one colony, the 3 younger nectophores of which are still connected. In these, the dorso-lateral knobs are considerably more prominent than in the type specimen of the species (cf. Fig. 20 with Bigelow, 1918, Pl. 4, Fig. 2—5). But it is probable that this apparent difference represents different phases of contraction in preservation, for the older "Thor" bells, up to 14 mm. long, agree with the original account of nectophores of corresponding sizes.

## **VOGTIA PENTACANTHA** Kölliker 1853.

*Vogtia pentacantha*, Kölliker, 1853, p. 31, Pl. 8, Fig. 1—8. For synonymy, see Moser, 1925, p. 416 (*Hippopodius pentacanthus*); Bigelow, 1918, p. 406, Pl. 4, Fig. 1; Browne, 1926, p. 61.

### Material.

St. 29. 40°47′ N., 12°55′ E. 20. I. 1909.
Y. 1650 m w. 6 nectoph.
St. 66. 36°16′ N., 6°52′ W. 25. II. 1909.
Y. 1200 m w. 8 nectoph.
St. 122. 43°50′ N., 8°34′ E. 2. VII. 1910.
Y. 1200 m w. 14 nectoph.
St. 129. 40°05′ N., 11°31′ E. 12. VII. 1910.
Y. 1000 m w. 3 nectoph.
St. 145. 32°38′ N., 19°02′ E. 25. VII. 1910.
Y. 300 m wire. 1 nectoph.
St. 147. 31°35′ N., 19°02′ E. 25. VII. 1910.
Y. 1000 m w. 8 nectoph.
St. 194. 38°33′ N., 15°29′ E. 21. VIII. 1910.
Y. 1200 m w. 2 nectoph.
St. 206. 39°32′ N., 5°15′ E. 28. VIII. 1910.
Y. 2000 m w. 9 nectoph.

### Questionable identification.

St. 31. 41°44′ N., 10°52′ E. 21. I. 1909.
Y. 1400 m w. 49 nectoph.
St. 91. 35°53′ N., 7°26′ W. 18. VI. 1910.
Y. 1600 m w. 19 nectoph.
St. 129. 40°05′ N., 11°31′ E. 12. VII. 1910.
Y. 1000 m w. 35 nectoph.
St. 147. 31°35′ N., 19°02′ E. 25. VII. 1910.
Y. 1000 m w. 26 nectoph.
St. 160. 35°59′ N., 28°14′ E. 1. VIII. 1910.
Y. 1000 m w. 11 nectoph.
St. 194. 38°33′ N., 15°29′ E. 21. VIII. 1910.
Y. 1200 m wire. 24 nectoph.
St. 199. 39°32′ N., 10°49′ E. 25. VIII. 1910.
Y. 1000 m w. 56 nectophores.
St. 206. 39°32′ N., 5°15′ E. 28. VIII. 1910.
Y. 1000 m wire. 5 nectoph.
St. 210. 41°10′ N., 2°23′ E. 30. VIII. 1910.
Y. 600 m w. 4 nectoph.
St. 281. 38°13′ N., 15°36.5′ E. 1. III. 1911.
S. 40 m w. 2 nectoph.
St. 282. 38°12′ N., 15°37′ E. 8. III. 1911.
S. 40 m w. 12 nectoph.

The foregoing list includes all the pentagonal hippopodid nectophores, on which the presence of thorns could be detected on the angles, but not on the facets. No doubt the list of doubtful Vogtias (p. 19) also includes some *pentacantha*.

In view of the large numbers of bells taken at some of the stations, the fact that they are all detached bears witness to the rough treatment that siphonophores receive when caught in large nets of rough texture, among the mass of other plankton.

## **VOGTIA SPINOSA** Keferstein and Ehlers 1861.

*Vogtia spinosa*, Keferstein and Ehlers, 1861, p. 24, Pl. 5, Fig. 16; Haeckel, 1888b, p. 364; Bigelow, 1911b, p. 210, Pl. 15, Fig. 5—12; 1931, p. 537; Leloup, 1933, p. 19.

*Vogtia köllikeri*, Haeckel, 1888b, p. 182, Pl. 29, Fig. 9—14.

*Hippopodius spinosus*, Moser, 1925, p. 419.

### Material.

St. 63. 35°50′ N., 6°03′ W. 22. II. 1909.
Y. 600 m w. 1 nectoph.
St. 65. 35°53′ N., 7°25′ W. 24. II. 1909.
Y. 600 m w. 12 nectoph.
St. 66. 36°16′ N., 6°52′ W. 25. II. 1909.
Y. 600 m w. 30 nectoph.
St. 68. 36°39′ N., 7°21′ W. 27. II. 1909.
Y. 800 m w. 30 nectoph.
St. 69. 36°13′ N., 9°44′ W. 28. II. 1909.
Y. 600 m w. 22 nectoph.
St. 71. 39°35′ N., 9°45′ W. 4. III. 1909.
Y. 600 m w. 8 nectoph.
Y. 1600 m w. 17 nectoph.
St. 81. 41°32′ N., 9°32′ W. 15. VI. 1910.
Y. 500 m w. 7 nectoph.
St. 89. 36°28′ N., 8°22′ W. 18. VII. 1910.
Y. 1000 m w. 15 nectoph.
St. 106. 36°33′ N., 2°00′ W. 25. VI. 1910.
Y. 1200 m w. 1 nectoph.
St. 115. 38°17′ N., 4°11′ E. 28. VI. 1910.
Y. 2000 m w. 2 nectoph.
St. 138. 37°37′ N., 11°25′ E. 19. VII. 1910.
Y. 1000 m w. 10 nectoph.
St. 139. 37°57′ N., 11°54′ E. 20. VII. 1910.
Y. 800 m w. 25 nectoph.
St. 144. 34°31′ N., 18°40′ E. 23. VII. 1910.
Y. 2000 m. w. 3 nectoph. with bits of stem.
St. 189. 37°44′ N., 15°58′ E. 19. VIII. 1910.
Y. 1000 m w. 1 nectoph.

St. 194. 38°33′ N., 15°29′ E. 21. VIII. 1910.
Y. 1200 m w. 1 nectoph.
St. 206. 39°32′ N., 5°15′ E. 28. VIII. 1910.
Y. 2000 m w. 2 nectoph.
St. 234. 38°10′ N. 9°20′ W. 10. IX. 1910.
Y. 1000 m w. 3 nectoph.
St. 242. 46°19′ N., 6°48′ W. 16. IX. 1910.
C. 4350 m w. 6 nectoph.

Questionable identification.

St. 189. 37°44′ N., 15°58′ E. 19. VIII. 1910.
Y. 1000 m w. 1 nectoph.
St. 194. 38°33′ N., 15°29′ E. 21. VIII. 1910.
Y. 1200 m w. 1 nectoph.

These loose nectophores, few of which are in good condition, add nothing to previous accounts based on much better preserved material. The identification is based on the presence of thorns on facets as well as on the angles of the bell (p. 17).

## **VOGTIA SERRATA** Moser 1913, 1925.

*Hippopodius serratus*, Moser, 1915, p. 212; 1915b, p. 653; 1925, p. 420, Pl. 27, Fig. 6—8, Pl. 28, Fig. 4—9.

*Vogtia pentacantha*, Moser, 1912, p. 329; Bigelow, 1913, p. 66, Pl. 5, Fig. 7—9, Pl. 6, Fig. 6.

*Vogtia serrata*, Moser, 1913, p. 149; Bigelow, 1918, p. 405; 1931, p. 538; Leloup, 1933, p. 18.

Non *V. pentacantha*, Kölliker, 1853, p. 31.

Material.

St. 65. 35°53′ N., 7°26′ W. 24. II. 1909.
Y. 1600 m w. 10 nectoph.
St. 242. 46°19′ N., 6°48′ W. 16. IX. 1910.
C. 4350 m w. 13 nectoph.

This list includes all pentagonal hippopodid nectophores, which show no trace of thorns either on the facets or on the angles. In most cases some trace of denticulation is to be seen along the angles. But this is soon lost when the bells have undergone any appreciable degree of deterioration. They add nothing to previous accounts (see especially Moser, 1925; Bigelow, 1913).

## **VOGTIA PENTACANTHA** or **VOGTIA SPINOSA.**

Material.

St. 187. 37°54′ N., 18°02′ E. 18. VIII. 1910.
Y. 1000 m w. 43 nectoph.
St. 192. 38°07′ N., 15°35′ E. 20. VIII. 1910.
Y. 600 m w. 14 nectoph.
St. 194. 38°33′ N., 15°29′ E. 21. VIII. 1910.
Y. 1200 m w. 12 nectoph.

## **VOGTIA** sp.?

Material.

St. 10. 37°21′ N., 16°45′ E. 15. XII. 1908.
Y. 600 m w. 36 nectoph.
St. 12. 39°34′ N., 17°17′ E. 19. XII. 1908.
Y. 1000 m w. 3 nectoph. (fragmentary).
St. 24. 40°14′ N., 12°23′ E. 16. I. 1909.
Y. 600 m w. 19 nectoph.
St. 29. 40°47′ N., 12°55′ E. 20. I. 1909.
Y. 600 m w. 2 nectoph.
St. 34. 43°27′ N., 8°16′ E. 23. I. 1909.
Y. 25 m w. 2 nectoph.
St. 35. 43°36′ N., 7°36′ E. 28. I. 1909.
Y. 1600 m w. 3 nectoph.
St. 69. 36°13′ N., 9°44′ W. 28. II. 1909.
Y. 65 m w. 4 nectoph.
St. 71. 39°35′ N., 9°45′ W. 4. III. 1909.
Y. 600 m w. 6 nectoph.
Y. 1600 m w. 3 nectoph.
St. 75. 45°37′ N., 7°03′ W. 9. III. 1909.
Y. 600 m w. 2 nectoph.
St. 115. 38°17′ N., 4°11′ W. 28. VI. 1910.
Y. 300 m w. 2 nectoph.
St. 143. 35°18′ N., 16°25′ E. 22. VII. 1910.
Y. 1000 m w. 4 nectoph.
St. 144. 34°31′ N., 18°40′ E. 23. VII. 1910.
Y. 2000 m w. 5 nectoph.
C. 4000 m w. 3 nectoph.
St. 160. 35°59′ N., 28°14′ E. 1. VIII. 1910.
C. 4000 m w. 3 nectoph.
St. 186. 37°57′ N., 19°51′ E. 17. VIII. 1910.
Y. 1200 m w. 6 nectoph.
St. 189. 37°44′ N., 15°58′ E. 19. VIII. 1910.
Y. 1000 m w. 17 nectoph.
St. 192. 38°07′ N., 15°35′ E. 20. VIII. 1910.
Y. 300 m w. 4 nectoph.
Y. 600 m w. 4 nectoph.
St. 194. 38°33′ N., 15°29′ E. 21. VIII. 1910.
Y. 1200 m w. 23 nectoph.
St. 199. 39°32′ N., 10°49′ E. 25. VIII. 1910.
Y. 1000 m w. 2 nectoph.
St. 204. 38°52′ N., 7°43′ E. 27. VIII. 1910.
Y. 1000 m w. 29 nectoph.

St. 206. 39°32′ N., 5°15′ E. 28. VIII. 1910.
Y. 1000 m w. 6 nectoph.
St. 209. 40°34′ N., 3°03′ E. 29. VIII. 1910.
Y. 25 m w. 5 nectoph.
St. 210. 41°10′ N., 2°23′ E. 30. VIII. 1910.
Y. 600 m w. 4 nectoph.
St. 232. 36°28′ N., 9°06′ W. 9. IX. 1910.
Y. 300 m w. 3 nectoph.

### **HIPPOPODIIDAE** genus?

Hippopodid bells, too fragmentary for identification, even as to genus, were taken as follows:—

Material.

St. 13. 39°43′ N., 17°30′ E. 19. XII. 1908.
Y. 1000 m w. 50 nectoph.
St. 69. 36°13′ N., 9°44′ W. 28. II. 1909.
Y. 600 m w. 19 nectoph.
C. 3000 m w. 1 nectoph.
St. 74. 44°21′ N., 7°55′ W. 8. III. 1909.
Y. 600 m w. 7 nectoph.
St. 129. 40°05′ N., 11°31′ E. 12. VII. 1910.
Y. 25 m w. 1 nectoph.
St. 134. 37°37′ N., 10°17′ E. 15. VII. 1910.
Y. 25 m w. 1 nectoph.

# DIPHYIDAE Quoy and Gaimard 1827.

## **ABYLINAE** L. Agassiz 1862.

The collection contains large series of the three members of this subfamily that are at once the best known, and that have most frequently been reported from different expeditions, but none of the other Abylinae are represented at all.

## ENNEAGONUM Quoy and Gaimard 1827.

### **ENNEAGONUM HYALINUM** Quoy and Gaimard 1827.

Figs. 21—25.

*Enneagonum hyalinum*, Quoy and Gaimard, 1827, p. 18, Pl. 2D, Fig. 1—6.

*Cuboides vitreus*, Quoy and Gaimard, 1827, p. 19, Pl. 2E, Fig. 1—3. For synonymy, see Bigelow, 1911 b, p. 190 (*Cuboides vitreus*); Moser, 1925, p. 404 (*Cuboides vitreus*); Totton, 1932, p. 335; Leloup, 1933, p. 23.

Material.

St. 46. 37°17′ N. 6°00′ E. 7. II. 1909.
Y. 600 m w. 6 nectoph.; 8 eudox.
St. 47. 36°55′ N., 3°12′ E. 8. II. 1909.
Y. 300 m w. 2 nectoph.; 1 eudox.
St. 50. 37°02′ N., 1°17′ E. 17. II. 1909.
Y. 600 m w. 148 nectoph.; 78 eudox.; 7 gonoph.; 29 eudox. or nectoph. (fragm.).
Y. 1600 m w. 25 nectoph.; 9 eudox.; 21 bracts.
St. 51. 36°27′ N., 0°37′ W. 17. II. 1909.
Y. 300 m w. 33 nectoph.; 34 eudox.
St. 53. 36°13′ N., 1°28′ W. 18. II. 1909.
C. 2600 m w. 7 eudox.
St. 55. 36°46′ N., 2°18′ W. 19. II. 1909.
Y. 65 m w. 3 bracts.
St. 57. 36°40′ N., 3°30′ W. 20. II. 1909.
Y. 25 m w. 39 nectoph.; 221 eudox.; 12 gonoph.
Y. 200 m w. 13 nectoph.; 13 eudox.; 14 bracts; 1 gonoph.
St. 58. 36°36′ N., 4°24′ W. 20. II. 1909.
Y. 65 m w. 2 nectoph.; 32 eudox.; 13 bracts.
Y. 100 m w. 4 nectoph.; 6 eudox.; 2 gonoph.
St. 59. 36°02′ N., 4°24′ W. 21. II. 1909.
Y. 25 m w. 6 nectoph.; 28 eudox.; 2 gonoph.
Y. 100 m w. 196 nectoph.; 305 eudox.; 45 gonoph.
Y. 500 w. 130 nectoph.; 126 eudox.; 11 gonoph.
Y. 1200 m w. 131 nectoph.; 108 eudox.; 19 gonoph.; 14 nectoph. or eudox. (fragm.).
St. 61. 35°57′ N., 5°35′ W. 21. II. 1909.
Y. 600 m w. 12 eudox.; 18 bracts.
St. 62. 35°45′ N., 5°59′ W. 21. II. 1909.
Y. 25 m w. 3 bracts.
St. 63. 35°50′ N., 6°03′ W. 22. II. 1909.
Y. 25 m w. 2 eudox.
Y. 600 m w. 20 nectoph.; 21 eudox.; gonoph.
St. 65. 35°53′ N., 7°26′ W. 24. II. 1909.
Y. 65 m w. 1 nectoph.; 2 eudox.
Y. 300 m w. 12 nectoph.; 28 eudox.; 8 gonoph.
Y. 600 m w. 4 nectoph.; 8 eudox.
St. 66. 36°16′ N., 6°52′ W. 25. II. 1909.
Y. 65 m w. 1 nectoph.; 2 eudox.
Y. 300 m w. 8 nectoph.; 5 eudox.
Y. 600 m w. 45 nectoph.; 63 eudox.
Y. 1200 m w. 9 nectoph.; 3 eudox.
St. 68. 36°39′ N., 7°21′ W. 27. II. 1909.
Y. 800 m w. 9 nectoph.; 11 eudox.; 3 gonoph.
St. 69. 36°13′ N., 9°44′ W. 28. II. 1909.
Y. 300 m w. 9 nectoph.; 24 eudox.; 11 gonoph.
St. 70. 39°06′ N., 9°47′ W. 4. III. 1909.
Y. 65 m w. 1 nectoph.; 2 eudox.
St. 71. 39°35′ N., 9°45′ W. 4. III. 1909.
Y. 300 m w. 5 nectoph.; 1 eudox.
Y. 600 m w. 1 nectoph.
St. 87. 37°03′ N., 9°15′ W. 17. VI. 1910.
Y. 300 m w. 1 nectoph.
St. 89. 36°28′ N., 8°22′ W. 18. VI. 1910.
Y. 300 m w. 1 eudox.
St. 91. 35°53′ N., 7°26′ W. 18. VI. 1910.
Y. 1600 m w. 1 nectoph.; 3 eudox.
St. 94. 36°06′ N., 6°02′ W. 23. VI. 1910.
Y. 65 m w. 1 nectoph.

St. 95. 35°57′ N., 6°00′ W. 23. VI. 1910.
Y. 25 m w. 1 nectoph.? (fragm.).
Y. 65 m w. 3 nectoph.; 1 eudox.
Y. 300 m w. 6 nectoph.; 3 eudox.; 5 bracts.
St. 96. 35°48′ N., 5°58′ W. 23. VI. 1910.
Y. 65 m w. 1 nectoph.
St. 98. 35°57′ N., 5°35′ W. 23. VI. 1910.
Y. 65 m w. 4 nectoph.; 2 eudox.
St. 99. 36°02′ N., 5°16′ W. 23. VI. 1910.
Y. 65 m w. 51 nectoph.; 51 eudox.; 28 gonoph.
Y. 300 m w. 66 nectoph.; 204 eudox.; 98 gonoph.
St. 106. 36°33′ N., 2°00′ W. 25. VI. 1910.
Y. 300 m w. 6 nectoph.; 26 eudox.; 2 gonoph.
Y. 1200 m w. 67 nectoph.; 144 eudox.; 15 gonoph.
St. 107. 36°18′ N., 1°14′ W. 25. VI. 1910.
Y. 65 m w. 4 nectoph.
Y. 300 m w. 27 nectoph.; 65 eudox.; gonoph.
Y. 200 m w. 24 nectoph.; 74 eudox.; 16 gonoph.
St. 108. 36°03′ N., 0°27′ W. 25. VI. 1910.
Y. 65 m w. 4 eudox.
Y. 300 m w. 3 nectoph.; 20 eudox.; 4 gonoph.
St. 112. 36°56′ N., 2°15′ E. 27. VI. 1910.
Y. 300 m w. 117 nectoph.; 93 eudox.; 15 gonoph.
St. 113. 36°53′ N., 3°09′ E. 28. VI. 1910.
Y. 300 m w. 4 nectoph.; 4 eudox.; 4 fragm.
St. 118. 41°00′ N., 6°43′ E. 30. VI. 1910.
Y. 300 m w. 1 nectoph.
St. 204. 38°52′ N., 7°43′ E.
Y. 1000 m w. 2 nectoph.
St. 206. 39°32′ N., 5°15′ E. 28. VIII. 1910.
Y. 1000 m w. 2 nectoph.
St. 222. 35°53′ N., 0°57′ W. 4. IX. 1910.
Y. 300 m w. 36 nectoph.; 50 eudox.; 8 gonoph.; 24 nectoph. or eudox.? (fragm.).
St. 223. 36°13′ N., 1°28′ W. 5. IX. 1910.
Y. 300 m w. 3 eudox.
St. 228. 36°02′ N., 5°06′ W. 7. IX. 1910.
Y. 25 m w. 12 nectoph.; 37 eudox.; 3 gonoph.
St. 229. 35°51′ N., 5°58′ W. 8. IX. 1910.
Y. 300 m w. 2 nectoph.
St. 232. 36°28′ N., 9°06′ W. 9. IX. 1910.
Y. 1000 m w. 1 nectoph.

The history of this species illustrates the degree to which the nomenclature of siphonophores has been confused by uncertainty as to the actual identity of species described from the early exploring expeditions: uncertainty in this case, as to whether or not, QUOY and GAIMARD's pictures of *Enneagonum* represented the form subsequently described by HUXLEY (1859) as *Abyla vogtii*, by HAECKEL (1888 b) as *Cymba crystallus* and by CHUN (1892) as *Halopyramis adamantina*.

In the most recent discussion of this subject, TOTTON (1932) pointed out that the original figures of *Enneagonum*, though distorted, correspond in all essential features with the nectophores of these latter. Consequently he re-introduced this name, and his lead is followed by LELOUP (1933, 1934); also here in the hope that the name *Enneagonum* may now have found its final resting place. It has long been fully established that this is the parent of the eudoxid first described by QUOY and GAIMARD (1827) as *Cuboides vitreus*, synonyms of which are *Cuboides crystallus* HAECKEL, and *Cuboides adamantina*, CHUN[1].

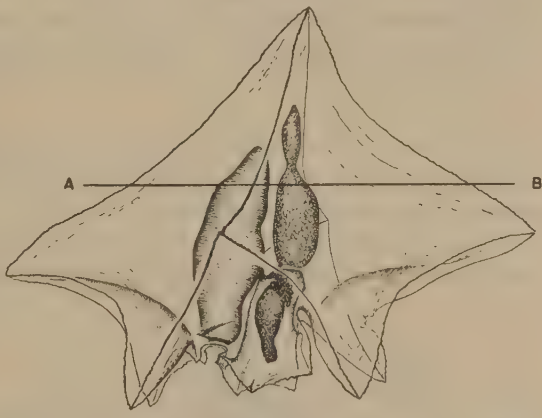

Fig. 21. *Enneagonum hyalinum*; general view of a colony, 13.5 mm. high, from the Philippines, "Albatross" St. 5500.

Colony. This is one of the best-characterized of Calycophorae, its polygastric generation being made easily recognizable by the pyramidal form and nine prominent angles of the nectophore, the eudoxid by its cubical bract.

The "Thor" specimens are all more or less damaged, especially the gelatinous angles of the nectophores. But comparison with several excellent examples from the Philippines, and with others from the Eastern Tropical Pacific fails to show anything to separate the Atlantic from the Pacific form. All agree very closely with CHUN's (1892) detailed description and pictures, which still remain the best and most complete account of the species.

In all the specimens of the polygastric generation that we have seen, Atlantic and Mediterranean as well as Pacific, the angles of the nectophore are produced into definite points (Fig. 21—23), much as they are figured by HAECKEL (1888 b) and by CHUN (1892), with the connecting ridges and intervening facets definitely (often deeply) concave, so that the bell has a somewhat stellate appearance. TOTTON's recent illustration (1932, Fig. 16) shows the angles as much less prominent, the ridges as more nearly straight, and the hydroecial region as relatively larger. As it was drawn from a small specimen (about 8 mm. high), these may be juvenile characters. But the fact that one specimen from the Eastern Tropical Pacific, only about 6 mm. high, is strongly stellate, with points relatively about as long as in the large specimen illustrated in Figure 21 shows that adult conformation may be attained in this respect at a very small size. Specimens in poor condition show a tendency for the points to lose prominence, the facets to lose concavity, and ridges to lose sharpness, apparently due to swelling of their gelatinous substance in preservation.

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[1] The selection of *Enneagonum* as the generic name, rather than *Cuboides*, is based on page-priority, *Enneagonum hyalinum* appearing on page 18, Quoy & Gaimard 1827; *Cuboides vitreus* on page 19. For further discussion see BIGELOW, 1911 b, p. 189; TOTTON, 1932, p. 336.

Totton's figure also shows a short transverse ridge at the apex, and this is present in one Philippine specimen. In the latter, the dorsal and right lateral ridges rise together, as do the ventral and the left lateral, with the transverse ridge connecting the points of origin of these two pairs (Fig. 23). In Totton's specimen it was the dorsal and left lateral, the ventral and right lateral that were paired. But it seems that such variations are unusual, for in all other good specimens examined, the four descending ridges arise at one point, at the sharply pointed apex (Fig. 21).

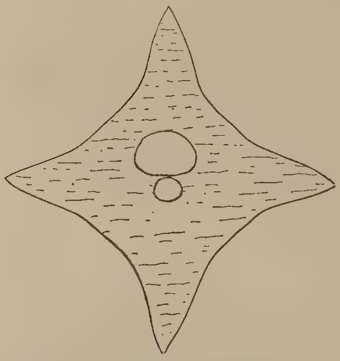

Fig. 22. *Enneagonum hyalinum*; optical section of specimen about 13 mm. high from the Philippines, "Albatross" St. 5500, at the level marked AB in Fig. 21.

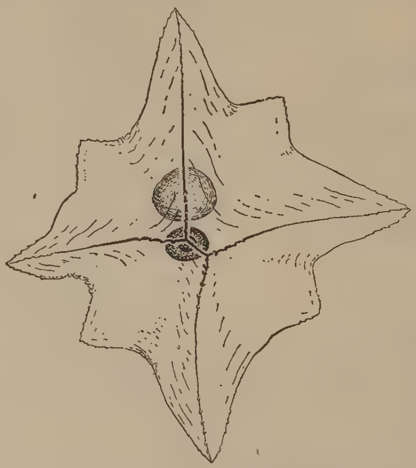

Fig. 23. *Enneagonum hyalinum*; apical view of another nectophore from the Philippines, "Albatross" St. 5500.

As no recent account of the basal part of the bell has appeared, it is worth mention that Chun's (1892) description of the oral margin of the nectosac as having two prominent lateral teeth only (besides the ventral lamella) was correct. The additional dorsal tooth with which Haeckel (1888 b) credited it, is non-existent. Chun (1892), and latterly Leloup (1934), have commented on the very characteristic asymmetry of the basal margin of the hydroecium (overlooked by Haeckel), the two sides of which differ in outline in a way easier illustrated (Fig. 25) than described. In every specimen so far examined, it has been the left-hand side that has borne the more prominent angles.

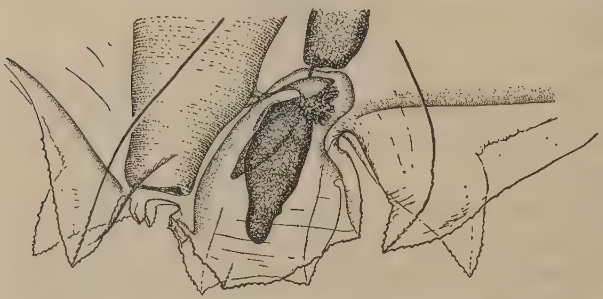

Fig. 24. *Enneagonum hyalinum*; lateral view of basal portion of the nectophore shown in Fig. 21.

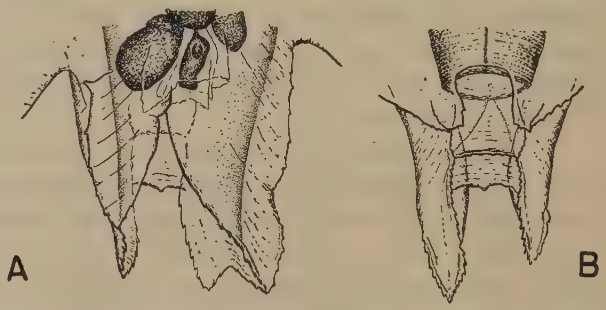

Fig. 25. *Enneagonum hyalinum*; A. Ventral view of nectophore from "Thor" St. 99; B. Dorsal view of the same specimen. × 8.5.

It is also worth noting, since not previously clearly stated[1], that the dorsal hydroecial wall, below the level of the opening of the nectosac, is divided, by a transverse denticulate ridge, into two distinct facets, lying at an angle of approximately 90° one with the other, (Figs. 24, 25), so that the hydroecial cavity here forms a re-entrant pocket.

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[1] This is indicated, however, in Chun's figure (1892, Pl. 12, Fig. 1).

In the better preserved specimens that we have seen, the hydroecium is not only laterally flattened, as Chun long ago remarked, but its two basal lips are closely pressed together. In more flaccid specimens, however, they are spread apart (Chun, 1892, Pl. 12, Fig. 1); no doubt this is the case in life, else there would be no passage for the stem.

The somatocyst is axial, as Chun observed, the nectosac eccentric toward the dorsal side, when the nectophore is viewed from the apex (Fig. 22). The nectophores of the "Thor" series range from 7 mm. to 15 mm. in height: 14 mm. was the greatest height previously recorded (Browne, 1926, p. 60).

Eudoxid. The eudoxids being well known, and perhaps the most easily recognized of all calycophore eudoxids (beautifully figured by Chun, 1892), the rather fragmentary specimens collected by the "Thor" call for no special comment. For a recent discussion of the homologies between the bracts of various Abylinae, with respect to ridges and facets, see Totton (1932, p. 337).

## ABYLOPSIS Chun 1888.

### **ABYLOPSIS TETRAGONA** Otto 1823.

*Pyramis tetragona*, Otto, 1823, p. 306, Pl. 42, Figs. 2a—2e. For synonymy, see Bigelow, 1911b, p. 224; 1931, p. 544; Browne, 1926, p. 63; Leloup, 1933, p. 21; Moser, 1925, p. 320 (*Abylopsis pentagona*).

### Material.

St. 10. 37°21′ N., 16°45′ E. 15. XII. 1908.
Y. 25 m w. 5 col.; 1 sup. nectoph.; 6 inf. nectoph; 8 eudox.; 8 gonoph.
Y. 65 m w. 1 col.
Y. 600 m w. 3 col.; 9 sup. nectoph.; 8 inf. nectoph.; 5 eudox.; 3 gonoph.
St. 11. 36°57′ N., 18°16′ E. 16. XII. 1908.
Y. 25 m w. 7 col.; 15 sup. nectoph.; 8 inf. nectoph.; 18 eudox.; 9 gonoph.
Y. 1000 m w. 4 inf. nectoph.
St. 13. 39°43′ N., 17°30′ E. 19. XII. 1908.
Y. 15 m w. 9 col.; 14 inf. nectoph.
Y. 1000 m w. 1 col.; 1 gonoph.
St. 15. 40°04′ N., 19°06′ E. 22. XII. 1908.
Y. 25 m w. 2 col.; 4 sup. nectoph.; 12 inf. nectoph.
Y. 1200 m w. 1 col.; 11 inf. nectoph.
St. 20. 37°48′ N., 15°49′ E. 5. I. 1909.
Y. 25 m w. 3 col.; 2 sup. nectoph.; 3 inf. nectoph.
St. 21. 37°51′ N., 15°21′ E. 5. I. 1909.
Y. 10 m w. 2 inf. nectoph.
St. 22. 38°50′ N., 15°18′ E. 7. I. 1909.
Y. 200 m w. 4 col.; 16 inf. nectoph.
St. 23. 40°34′ N., 13°24′ E. 15. I. 1909.
Y. 25 m w. 13 col.; 9 inf. nectoph.
St. 24. 40°14′ N., 12°23′ E. 16. I. 1909.
Y. 25 m w. 37 col.; 3 sup. nectoph.; 39 inf. nectoph.
Y. 65 m w. 20 col.; 7 sup. nectoph.; 44 inf. nectoph.; 2 eudox.; 2 gonoph.
Y. 300 m w. 3 col.
Y. 600 m w. 3 col.; 4 sup. nectoph.; 8 inf. nectoph.
St. 26. 40°40′ N., 13°59′ E. 18. I. 1909.
Y. 150 m w. 1 sup. nectoph.; 23 inf. nectoph.
Y. 300 m w. 4 col.; 4 sup. nectoph.; 6 inf. nectoph.; 3 eudox.
St. 27. 40°58′ N., 13°49′ E. 19. I. 1909.
Y. 25 m w. 1 col.; 2 inf. nectoph.
St. 28. 40°53′ N., 13°43′ E. 19. I. 1909.
Y. 25 m w. 5 col.; 5 inf. nectoph.
St. 29. 40°47′ N., 12°55′ E. 20. I. 1909.
Y. 200 m w. 12 col.; 2 sup. nectoph.; 16 inf. nectoph.; 4 eudox.
Y. 600 m w. 9 col.; 4 sup. nectoph.; 11 inf. nectoph.
Y. 1650 m w. 3 col.; 1 inf. nectoph.
St. 30. 41°15′ N., 11°55′ E. 21. I. 1909.
Y. 65 m w. 3 col.; 1 inf.
St. 31. 41°44′ N., 10°52′ E. 21. I. 1909.
Y. 65 m w. 16 col.; 4 sup. nectoph.; 34 inf. nectoph.; 1 eudox.
Y. 200 m w. 4 sup. nectoph.
Y. 600 m w. 14 sup. nectoph.; 1 inf. nectoph.
Y. 1400 m w. 1 col.; 2 sup. nectoph.
St. 34. 43°27′ N., 8°16′ E. 23. I. 1909.
Y. 25 m w. 1 inf. nectoph.
Y. 200 m w. 1 col.; 1 sup. nectoph.; 4 inf. nectoph.; 1 eudox.
St. 35. 43°36′ N., 7°36′ E. 28. I. 1909.
Y. 200 m w. 3 col.; 39 inf. nectoph.
Y. 300 m w. 10 col.; 6 sup. nectoph.; 10 inf. nectoph.
S. 700 m w. 6 col.; 4 inf. nectoph.
S. 1000 m w. 3 sup. nectoph.; 3 inf. nectoph.
Y. 1600 m w. 3 col.; 3 sup. nectoph.; 6 inf. nectoph.; 5 eudox.; 1 gonoph.
C. 2500 m w. 1 sup. nectoph.; 3 inf. nectoph.
St. 36. 42°49′ N., 6°54′ E. 30. I. 1909.
Y. 300 m w. 3 inf. nectoph.; 2 eudox.
St. 38. 40°45′ N., 9°50′ E. 31. I. 1909.
Y. 25 m w. 2 inf. nectoph.
Y. 65 m w. 1 col.; 3 inf. nectoph.
Y. 150 m w. 1 inf. nectoph.
St. 39. 39°41′ N., 10°02′ E. 1. II. 1909.
Y. 25 m w. 9 sup. nectoph.; 23 inf. nectoph.; 5 eudox.; 4 gonoph.
Y. 65 m w. 1 eudox.
Y. 300 m w. 1 inf. nectoph.
St. 40. 39°10′ N.‘ 9°40′ E. 1. II. 1909.
Y. 65 m w. 6 col.; 12 inf. nectoph.; 12 eudox.; 2 gonoph.
St. 42. 38°58′ N., 9°37′ E. 2. II. 1909.
Y. 300 m w. 5 col.; 2 inf. nectoph.
St. 43. 38°14′ N., 8°42′ E. 3. II. 1909.
Y. 65 m w. 8 col.; 2 sup. nectoph.; 6 inf. nectoph.; 3 eudox.; 5 gonoph.
St. 46. 37°17′ N., 6°00′ E. 7. II. 1909.
Y. 65 m w. 38 col.; 3 sup. nectoph.; 25 inf. nectoph.; 1 eudox.; 1 gonoph.
Y. 300 m w. 12 col.; 1 sup. nectoph.; 9 inf. nectoph.
Y. 600 m w. 99 col.; 79 sup. nectoph.; 233 inf. nectoph.; 12 eudox.; 7 gonoph.

St. 47. 36°55′ N., 3°12′ E. 8. II. 1909.
Y. 65 m w. 5 col.; 3 sup. nectoph.; 6 inf. nectoph.; 18 eudox.; 3 gonoph.
Y. 300 m w. 34 col.; 52 sup. nectoph.; 72 inf. nectoph.; 19 eudox.; 13 gonoph.

St. 50. 37°02′ N., 1°17′ E. 17. II. 1909.
Y. 25 m w. 32 col.; 24 sup. nectoph.; 137 inf. nectoph.; 50 eudox.; 36 gonoph.
Y. 65 m w. 87 col.; 35 sup. nectoph.; 120 inf. nectoph.; 26 eudox.; 29 gonoph.
Y. 300 m w. 20 col.; 5 sup. nectoph.; 12 inf. nectoph.; 12 eudox.; 4 gonoph.
Y. 600 m w. 8 col.; 5 sup. nectoph.; 20 inf. nectoph.; 1 eudox.
Y. 1600 m w. 13 col.; 1 sup. nectoph.; 9 inf. nectoph.; 2 eudox.

St. 51. 36°27′ N., 0°37′ W. 18. II. 1909.
Y. 300 m w. 26 col.; 8 sup. nectoph.; 23 inf. nectoph.; 20 eudox.; 4 gonoph.

St. 52. 35°55′ N., 1°02′ W. 18. II. 1909.
Y. 300 m w. 1 inf. nectoph.; 2 eudox.; 2 gonoph.

St. 53. 36°13′ N., 1°28′ W. 18. II. 1909.
C. 2600 m w. 9 col.; 4 inf. nectoph.

St. 55. 36°46′ N., 2°18′ W. 19. II. 1909.
Y. 25 m w. 5 inf. nectoph.
Y. 65 m w. 7 inf. nectoph.; 4 eudox.; 2 gonoph.

St. 57. 36°40′ N., 3°30′ W. 20. II. 1909.
Y. 25 m w. 2 col.; 1 sup. nectoph.; 1 inf. nectoph.
Y. 200 m w. 1 col.; 5 inf. nectoph.

St. 58. 36°36′ N., 4°24′ W. 20. II. 1909.
Y. 65 m w. 1 col.; 1 sup. nectoph.; 5 inf. nectoph.
Y. 100 m w. 2 col.

St. 59. 36°02′ N., 4°24′ W. 21. II. 1909.
Y. 25 m w. 100 col.; 50 sup. nectoph.; 135 inf. nectoph.
Y. 100 m w. 26 col.; 16 sup. nectoph.; 40 inf. nectoph.
Y. 500 m w. 198 col.; 48 sup. nectoph.; 146 inf. nectoph.
Y. 1200 m w. 128 col.; 131 sup. nectoph.; 148 inf. nectoph.

St. 61. 35°57′ N., 5°35′ W. 21. II. 1909.
Y. 600 m w. 57 col.; 29 sup. nectoph.; 44 inf. nectoph.

St. 63. 35°50′ N., 6°03′ W. 22. II. 1909.
Y. 25 m w. 1 col.
Y. 600 m w. 1 col.; 6 inf. nectoph.

St. 66. 36°16′ N., 6°52′ W. 25. II. 1909.
Y. 300 m w. 1 inf. nectoph.
Y. 600 m w. 4 sup. nectoph.; 4 inf. nectoph.

St. 69. 36°13′ N., 9°44′ W. 28. II. 1909.
Y. 25 m w. 1 inf. nectoph.? (fragm.).
Y. 600 m w. 8 sup. nectoph.; 1 inf. nectoph.; 18 eudox.; 5 gonoph.

St. 71. 39°35′ N., 9°45′ W. 4. III. 1909.
Y. 300 m w. 1 inf. nectoph.

St. 74. 44°21′ N., 7°55′ W. 9. III. 1909.
Y. 600 m w. 1 inf. nectoph.

St. 94. 36°06′ N., 6°02′ W. 23. VI. 1910.
Y. 65 m w. 1 inf. nectoph.

St. 95. 35°57′ N., 6°00′ W. 23. VI. 1910.
Y. 25 m w. 7 sup. nectoph.; 8 inf. nectoph.; 5 eudox.
Y. 65 m w. 5 col.; 3 sup. nectoph.; 2 inf. nectoph.; 37 eudox.
Y. 300 m w. 1 col.; 4 sup. nectoph.; 4 inf. nectoph.

St. 98. 35°57′ N. 5°35′ W. 23. VI. 1910.
Y. 65 m w. 12 col.; 39 sup. nectoph.; 40 inf. nectoph.; 48 eudox.

St. 99. 36°02′ N., 5°16′ W. 23. VI. 1910.
Y. 65 m w. 2 col.; 6 sup. nectoph.; 6 inf. nectoph.; 12 eudox.
Y. 300 m w. 56 col.; 48 inf. nectoph.; 43 eudox.

St. 104. 36°37′ N., 2°04′ W. 24. VI. 1910.
Y. 65 m w. 4 col.; 5 sup. nectoph.; 5 inf. nectoph.; 6 eudox.

St. 106. 36°33′ N., 2°00′ W. 25. VI. 1910.
Y. 300 m w. 92 sup. nectoph.; 94 inf. nectoph.; 75 eudox.; 20 gonoph.
Y. 1200 m w. 35 col.; 42 sup. nectoph.; 59 inf. nectoph.; 9 eudox.

St. 107. 36°18′ N., 1°14′ W. 25. VI. 1910.
Y. 65 m w. 3 col.; 49 sup. nectoph.; 36 inf. nectoph.; 308 eudox.; 196 gonoph.
Y. 300 m w. 20 sup. nectoph.; 17 inf. nectoph.; 71 eudox.; gonoph.
Y. 2000 m w. 126 col.; 76 sup. nectoph.; 128 inf. nectoph.; 17 eudox.

St. 108. 36°03′ N., 0°27′ W. 25. VI. 1910.
Y. 25 m w. 2 eudox.
Y. 65 m w. 1 col.; 32 sup. nectoph.; 5 inf. nectoph.; 185 eudox.; 74 gonoph.
Y. 300 m w. 17 col.; 27 sup. nectoph.; 38 inf. nectoph.; 22 eudox.; 2 gonoph.

St. 112. 36°56′ N., 2°15′ E. 26. VI. 1910.
Y. 25 m w. 61 sup. nectoph.; 43 eudox.; 14 gonoph.
Y. 65 m w. 2 col.; 443 sup. nectoph.; 16 inf. nectoph.; 556 eudox.; 160 gonoph.
Y. 300 m w. 10 col.; 23 sup. nectoph.; 31 inf. nectoph.; 40 eudox.

St. 113. 36°53′ N., 3°09′ E. 28. VI. 1910.
Y. 300 m w. 101 col.; 76 sup. nectoph.; 104 inf. nectoph.; 20 eudox.

St. 115. 38° 17′ N., 4° 11′ E. 28. VI. 1910.
Y. 25 m w. 164 sup. nectoph.; 1 inf. nectoph.; 181 eudox.; 46 gonoph.
Y. 65 m w. 6 col.; 158 sup. nectoph.; 3 inf. nectoph.; 164 eudox.; 20 gonoph.
Y. 300 m w. 75 col.; 90 sup. nectoph.; 127 inf. nectoph.; 13 eudox.; 1 gonoph.
Y. 2000 m w. 47 sup. nectoph.; 26 inf. nectoph.; 32 eudox.; 6 gonoph.

St. 116. 39°27′ N., 5°26′ E. 29. VI. 1910.
Y. 25 m w. 3 col.; 412 sup. nectoph.; 19 inf. nectoph.; 273 eudox.; 125 gonoph.
Y. 65 m w. 1 col.; 38 sup. nectoph.; 1 inf. nectoph.; 19 eudox.; 17 gonoph.
Y. 300 m w. 22 col.; 58 sup. nectoph.; 39 inf. nectoph.; 14 eudox.

St. 118. 41°00′ N., 6°43′ E. 30. VI. 1910.
Y. 25 m w. 40 sup. nectoph.; 19 inf. nectoph.; 35 eudox.; 25 gonoph.
Y. 65 m w. 15 col.; 11 sup. nectoph.; 34 inf. nectoph.; 4 eudox.
Y. 300 m w. 59 sup. nectoph.; 77 inf. nectoph.; 17 eudox.; 2 + gonoph.

St. 120. 42°31′ N., 7°41′ E. 1. VII. 1910.
Y. 300 m w. 7 sup. nectoph.; 7 inf. nectoph.; 3 eudox.; gonoph.

St. 121. 43°08′ N., 8°05′ E. 2. VII. 1910.
Y. 25 m w. 1 sup. nectoph.; 7 eudox.; 3 gonoph.

St. 122. 43°50′ N., 8°34′ E. 2. VII. 1910.
Y. 600 m w. 1 inf. nectoph.; 3 eudox.; 1 gonoph.
Y. 1200 m w. 14 sup. nectoph.; 18 inf. nectoph.; 3 eudox.

St. 123. 44°14′ N., 8°55′ E. 3. VII. 1910.
Y. 25 m w. 2 sup. nectoph.; 6 eudox.
Y. 65 m w. 10 col.; 125 sup. nectoph.; 5 inf. nectoph.; 743 eudox.; 339 gonoph.
Y. 300 m w. 12 sup. nectoph.; 14 inf. nectoph.; 7 eudox.; gonoph.
Y. 300 m w. 12 sup. nectoph.; 14 inf. nectoph.; 7 eudox.; gonoph.

St. 125. 43°54′ N., 9°13′ E. 9. VII. 1910.
Y. 25 m w. 2 sup. nectoph.; 2 inf. nectoph.; 11 eudox.; 5 gonoph.
Y. 300 m w. 48 sup. nectoph.; 51 inf. nectoph.; 3 eudox.

St. 126. 42°43′ N., 9°50′ E. 10. VII. 1910.
Y. 300 m w. 1 col.; 1 sup. nectoph.; 1 inf. nectoph.

St. 129. 40°05′ N., 11°31′ E. 12. VII. 1910.
Y. 300 m w. 20 sup. nectoph.; 24 inf. nectoph.
Y. 600 m w. 2 sup. nectoph.; 2 inf. nectoph.
Y. 1000 m w. 4 col.; 1 sup. nectoph.; 2 inf. nectoph.
C. 3500 m w. 3 col.; 2 sup. nectoph.; 3 inf. nectoph.

St. 130. 39°35′ N., 11°20′ E. 13. VII. 1910.
Y. 25 m w. 26 sup. nectoph.; 37 eudox.; 5 gonoph.

St. 131. 38°36′ N., 11°00′ E. 13. VII. 1910.
Y. 25 m w. 1 sup. nectoph.; 1 eudox.
Y. 300 m w. 1 sup. nectoph.
Y. 1000 m w. 5 col.; 5 sup. nectoph.; 3 inf. nectoph.

St. 132. 38°57′ N., 9°47′ E. 14. VII. 1910.
Y. 25 m wire. 4 sup. nectoph.; 1 inf. nectoph.; 5 eudox.; 5 ± gonoph.
Y. 300 m w. 3 col.; 2 sup. nectoph.; 4 inf. nectoph.
Y. 600 m w. 1 inf. nectoph.

St. 133. 38°18′ N., 9°59′ E. 14. VII. 1910.
Y. 25 m w. 206 sup. nectoph.; 11 inf. nectoph.; 189 eudox.; 20 gonoph.
Y. 300 m w. 25 sup. nectoph.; 31 inf. nectoph.; 4 eudox.
Y. 600 m w. 22 sup. nectoph.; 27 inf. nectoph.; 4 eudox.; 2 gonoph.

- St. 134. 37°37′ N., 10°17′ E. 15. VII. 1910.
  - Y. 25 m w. 521 sup. nectoph.; 174 inf. nectoph.; 107 eudox.; 40 ± gonoph.
  - Y. 300 m wire. 19 col.; 207 sup. nectoph.; 39 inf. nectoph.; 40 eudox.
- St. 135. 37°17′ N., 10°28′ E. 15. VII. 1910.
  - Y. 25 m w. 2 col.; 15 sup. nectoph.; 3 inf. nectoph.; 7 eudox.; 2 gonoph.
- St. 136. 37°01′ N., 10°31′ E. 19. VII. 1910.
  - Y. 25 m w. 1 col.; 3 sup. nectoph.; 3 inf. nectoph.
  - Y. 100 m w. 1 col.; 3 sup. nectoph.; 2 inf. nectoph.
- St. 137. 37°17′ N., 10°56′ E. 19. VII. 1910.
  - Y. 25 m w. 12 col.; 506 sup. nectoph.; 82 inf. nectoph.; 346 eudox.; 160 gonoph.
  - Y. 250 m w. 109 sup. nectoph.; 45 inf. nectoph.; 34 eudox.; 15 gonoph.
- St. 138. 37°37′ N., 11°25′ E. 19. VII. 1910.
  - Y. 25 m w. 2 col.; 200 + sup. nectoph.; 3 inf. nectoph.; 45 + eudox.; 10 gonoph.; 235 fragm.
  - Y. 300 m w. 14 col.; 21 sup. nectoph.; 23 inf. nectoph.
  - Y. 1000 m w. 96 col.; 111 sup. nectoph.; 127 inf. nectoph.; 23 eudox.; 6 gonoph.
- St. 139. 37°57′ N., 11°54′ E. 20. VII. 1910.
  - Y. 25 m w. 3 sup. nectoph.; 1 inf. nectoph.; 4 eudox.
  - Y. 300 m w. 32 col.; 71 sup. nectoph.; 58 inf. nectoph.; 8 eudox.; 1 gonoph.
  - Y. 800 m w. 15 col.; 14 sup. nectoph.; 16 inf. nectoph.; 4 eudox.
- St. 141. 36°42′ N., 13°34′ E. 20. VII. 1910.
  - Y. 25 m w. 1 inf. nectoph.
- St. 142. 35°44′ N., 15°07′ E. 22. VII. 1910.
  - Y. 25 m w. 1 sup. nectoph.
  - Y. 150 m w. 48 sup. nectoph.; 1 inf. nectoph.; 4 eudox.
- St. 143. 35°18′ N., 16°25′ E. 22. VII. 1910.
  - Y. 300 m w. 12 col.; 2 sup. nectoph.; 15 inf. nectoph.
  - Y. 1000 m w. 2 col.; 5 sup. nectoph.; 5 inf. nectoph.; 1 eudox.
- St. 144. 34°31′ N., 18°40′ E. 24. VII. 1910.
  - Y. 300 m w. 1 col.
- St. 145. 32°38′ N., 19°02′ E. 25. VII. 1910.
  - Y. 300 m w. 2 col.; 3 sup. nectoph.; 2 inf. nectoph.
- St. 147. 31°35′ N., 19°02′ E. 25. VII. 1910.
  - Y. 25 m w. 1 inf. nectoph.
- St. 186. 37°57′ N., 19°51′ E. 17. VIII. 1910.
  - Y. 65 m w. 6 sup. nectoph.; 7 inf. nectoph.; 1 eudox.; 5 gonoph.
  - Y. 300 m w. 2 sup. nectoph.; 3 inf. nectoph.
  - Y. 1200 m w. 2 sup. nectoph.; 3 inf. nectoph.
- St. 187. 37°54′ N., 18°02′ E. 18. VIII. 1910.
  - Y. 1000 m w. 2 sup. nectoph.; 3 inf. nectoph.
- St. 189. 37°44′ N., 15°58′ E. 19. VIII. 1910.
  - Y. 100 m w. 1 col.
- St. 190. 37°51′ N., 15°19′ E. 19. VIII. 1910.
  - Y. 25 m w. 4 sup. nectoph.; 8 eudox.
- St. 192. 38°07′ N., 15°35′ E. 20. VIII. 1910.
  - Y. 25 m w. 1 sup. nectoph.; 5 eudox.
  - Y. 300 m w. 5 col.; 10 sup. nectoph.; 18 inf. nectoph.
  - Y. 600 m w. 10 col.; 26 sup. nectoph.; 20 inf. nectoph.
- St. 193. 38°15′ N., 15°39′ E. 21. VIII. 1910.
  - Y. 10 m w. 3 sup. nectoph.; 1 inf. nectoph.; 24 eudox.; 3 gonoph.
- St. 194. 38°33′ N., 15°29′ E. 21. VIII. 1910.
  - Y. 10 m w. 1 sup. nectoph.; 4 eudox.
  - Y. 25 m w. 10 sup. nectoph.; 1 inf. nectoph.; 41 eudox.; 16 gonoph.
  - Y. 1200 m w. 4 col.; 1 sup. nectoph.; 4 eudox.
- St. 195. 39°02′ N., 14°55′ E. 21. VIII. 1910.
  - Y. 25 m w. 6 sup. nectoph.; 16 eudox.; 2 gonoph.
  - Y. 300 m w. 1 sup. nectoph.; 1 inf. nectoph.
- St. 197. 40°34′ N., 13°36′ E. 24. VIII. 1910.
  - Y. 300 m w. 3 col.; 5 sup. nectoph.; 3 inf. nectoph.
- St. 199. 39°32′ N., 10°49′ E. 25. VIII. 1910.
  - Y. 25 m w. 1 col.
  - Y. 300 m w. 5 sup. nectoph.; 6 inf. nectoph.; 2 eudox.
  - Y. 1000 m w. 3 col.; 3 sup. nectoph.; 2 inf. nectoph.
- St. 204. 38°52′ N., 7°43′ E. 27. VIII. 1910.
  - Y. 25 m w. 1 col.; 4 sup. nectoph.; 4 inf. nectoph.
  - Y. 65 m w. 1 col.; 5 sup. nectoph.; 3 inf. nectoph.; 9 eudox.
  - Y. 300 m w. 61 col.; 46 sup. nectoph.; 72 inf. nectoph.; 1 eudox.
  - Y. 1000 m w. 38 col.; 21 sup. nectoph.; 21 inf. nectoph.; 5 eudox.
- St. 205. 39°16′ N., 5°52′ E. 27. VIII. 1910.
  - Y. 25 m w. 223 sup. nectoph.; 206 inf. nectoph.; 22 eudox.
- St. 206. 39°32′ N., 5°15′ E. 28. VIII. 1910.
  - Y. 25 m w. 8 col.; 22 sup. nectoph.; 45 inf. nectoph.; 8 eudox.; 3 gonoph.
  - Y. 300 m w. 40 col.; 75 sup. nectoph.; 107 inf. nectoph.; 21 eudox.; 5 gonoph.
  - Y. 1000 m w. 36 col.; 79 sup. nectoph.; 105 inf. nectoph.; 29 eudox.; 1 gonoph.
  - Y. 2000 m w. 148 sup. nectoph.; 142 inf. nectoph.; 22 eudox.; 10 gonoph.
- St. 207. 39°58′ N., 3°41′ E. 28. VIII. 1910.
  - Y. 25 m w. 2 sup. nectoph.; 1 gonoph.
  - Y. 65 m w. 28 sup. nectoph.; 4 inf. nectoph.; 25 eudox.
- St. 208. 40°18′ N., 3°20′ E. 29. VIII. 1910.
  - Y. 25 m w. 6 sup. nectoph.
- St. 209. 40°34′ N., 3°03′ E. 29. VIII. 1910.
  - C. 0—35 m w. 3 sup. nectoph.
  - C. 150 m w. 1 col.; 41 sup. nectoph.; 8 inf. nectoph.; 168 eudox.; 26 gonoph.
  - Y. 25 m w. 1 col.; 31 sup. nectoph.; 122 eudox.; 35 gonoph.
  - Y. 100 m w. 18 sup. nectoph.; 6 inf. nectoph.; 56 eudox.; 11 gonoph.
  - Y. 300 m w. 9 sup. nectoph.; 12 eudox.; 4 gonoph.
  - Y. 2000 m w. 4 col.; 4 sup. nectoph.; 10 eudox.; 3 gonoph.
- St. 210. 41°10′ N., 2°23′ E. 30. VIII. 1910.
  - Y. 25 m w. 1 col.
  - Y. 600 m w. 2 col.; 5 sup. nectoph.; 6 inf. nectoph.; 1 eudox.
- St. 215. 39°14′ N., 0°52′ E. 31. VIII. 1910.
  - Y. 25 m w. 5 sup. nectoph.; 2 inf. nectoph.; 5 eudox.
- St. 216. 38°31′ N., 1°24′ E. 1. IX. 1910.
  - Y. 25 m w. 6 sup. nectoph.; 15 inf. nectoph.
- St. 217. 38°01′ N., 1°48′ E. I. IX. 1910.
  - Y. 300 m w. 13 col.; 9 sup. nectoph.; 13 inf. nectoph.; 2 eudox.
- St. 218. 36°54′ N., 2°57′ E. 2. IX. 1910.
  - Y. 25 m w. 18 sup. nectoph.; 18 inf. nectoph.; 2 eudox.; 4 gonoph.
- St. 220. 36°25′ N., 0°42′ E. 4. IX. 1910.
  - Y. 25 m w. 17 col.; 6 sup. nectoph.; 23 inf. nectoph.; 1 eudox.
- St. 221. 35°44′ N., 0°53′ W. 4. IX. 1910.
  - Y. 25 m w. 7 col.; 1292 sup. nectoph.; 98 inf. nectoph.; 5926 eudox.; 2769 gonoph.
- St. 222. 35°53′ N., 0°57′ W. 4. IX. 1910.
  - Y. 300 m w. 34 col.; 58 sup. nectoph.; 72 inf. nectoph.; 13 eudox.; 11 gonoph.
- St. 223. 36°13′ N., 1°28′ W. 5. IX. 1910.
  - Y. 25 m w. 7 sup. nectoph.; 1 eudox.; 1 gonoph.
  - Y. 300 m w. 73 col.; 30 sup. nectoph.; 76 inf. nectoph.
- St. 225. 36°35′ N., 3°00′ W. 6. IX. 1910.
  - Y. 25 m w. 41 sup. nectoph.; 316 eudox.; 96 gonoph.
- St. 228. 36°02′ N., 5°06′ W. 7. IX. 1910.
  - Y. 25 m w. 12 col.; 6 sup. nectoph.; 13 inf. nectoph.; 2 eudox.
  - Y. 800 m w. 206 col.; 169 sup. nectoph.; 234 inf. nectoph.; 24 eudox.; 7 gonoph.
- St. 229. 35°51′ N., 5°58′ W. 8. IX. 1910.
  - Y. 300 m w. 1 inf. nectoph.
- St. 245. 47°14′ N., 6°02′ W. 17. IX. 1910.
  - Y. 250 m w. 1 eudox.
- St. 278. 38°11.5′ N., 15°37.5′ E. 22. II. 1911.
  - S. 15 m w. 1 col.; 1 sup. nectoph.; 7 eudox.; 1 gonoph.
- St. 279. 38°11.5′ N., 15°36.5′ E. 23. II. 1911.
  - S. 30 m w. 1 col.; 6 eudox.
- St. 280. 38°11′ N., 15°36.5′ E. 25. II. 1911.
  - S. 15 m w. 1 sup. nectoph.; 5 eudox.; 7 gonoph.
- St. 281. 38°15′ N., 15°37.5′ E. 1. III. 1911.
  - S. 10 m w. 1 sup. nectoph.; 1 inf. nectoph.
  - S. 30 m w. 1 col.; 1 sup. nectoph.; 1 inf. nectoph.; 1 eudox.
  - S. 40 m w. 2 col.; 7 eudox.; 4 gonoph.
- St. 282. 38°12′ N., 15°37′ E. 8. III. 1911.
  - S. 40 m w. 1 col.; 4 sup. nectoph.; 3 inf. nectoph.; 17 eudox.; 5 gonoph.
- St. 283. 38°12′ N., 15°37′ E. 12. III. 1911.
  - S. 40 m w. 6 sup. nectoph.; 2 inf. nectoph.; 5 eudox.; 2 gonoph.

The reasons that necessitate reviving Otto's name *tetragona*, for this species, are stated elsewhere (Bigelow, 1911b, p. 224; 1931, p. 545).

Most of the "Thor" specimens are more or less battered. There is, however, no danger of confusing the inferior nectophores of *A. tetragona* with those of any other species. The conformation of the bract of the free eudoxid is equally distinctive, for the relative sizes of the apico-lateral and baso-lateral facets differ widely from those of *A. eschscholtzii*, the only other abylid in which the bracteal somatocyst is of similar form[1]. For discussions of the criteria by which superior nectophores are distinguishable from those of *A. eschscholtzii*, which they closely resemble in general appearance, see Browne, 1926, p. 64; Bigelow, 1931, p. 547; Totton 1932, p. 335.

## BASSIA L. Agassiz 1862.

### **BASSIA BASSENSIS** Quoy and Gaimard 1834.

*Diphyes bassensis*, Quoy & Gaimard, 1834, p. 91, Pl. 4, Figs. 18—20.

For synonymy, see Bigelow, 1911b, p. 229; Moser, 1925, p. 347; Leloup, 1933, p. 24.

Material.

- St. 7. 37°00′ N., 9°07′ W. 4. XII. 1908.
  - Y. 65 m w. 2 inf. nectoph.
- St. 10. 37°21′ N., 16°45′ E. 15. XII. 1908.
  - Y. 25 m w. 2 col.; 11 sup. nectoph.; 2 inf. nectoph.; 28 eudox.; 2 gonoph.
  - Y. 65 m w. 1 sup. nectoph.; 1 eudox.
  - Y. 600 m w. 5 sup. nectoph.; 3 eudox.
- St. 11. 36°57′ N., 18°16′ E. 16. XII. 1908.
  - Y. 25 m w. 15 sup. nectoph.; 8 inf. nectoph.; 21 eudox.
- St. 38. 40°45′ N., 9°50′ E. 31. I. 1909.
  - Y. 150 m w. 1 inf. nectoph.
- St. 43. 38°14′ N., 8°42′ E. 3. II. 1909.
  - Y. 65 m w. 1 bract.
- St. 47. 36°55′ N., 3°12′ E. 8. II. 1909.
  - Y. 65 m w. 1 bract.
- St. 63. 35°50′ N., 6°03′ W. 21. II. 1909.
  - Y. 25 m w. 6 inf. nectoph.; 1 eudox.
- St. 65. 35°53′ N., 7°26′ W. 24. II. 1909.
  - Y. 25 m w. 3 sup. nectoph.; 4 inf. nectoph.
  - Y. 65 m w. 3 sup. nectoph.; 17 inf. nectoph.; 14 eudox.; 4 gonoph.
  - Y. 300 m w. 2 sup. nectoph.; 3 inf. nectoph.; 3 eudox.
  - Y. 600 m w. 1 inf. nectoph.
- St. 66. 36°16′ N., 6°52′ W. 25. II. 1909.
  - Y. 25 m w. 1 inf. nectoph.
  - Y. 300 m w. 1 sup. nectoph.
- St. 68. 36°39′ N., 7°21′ W. 27. II. 1909.
  - Y. 800 m w. 1 inf. nectoph.; 1 gonoph.
- St. 69. 36°13′ N., 9°44′ W. 28. II. 1909.
  - Y. 25 m w. 2 sup. nectoph.; 21 eudox.; 2 gonoph.; 10 fragm.
  - Y. 65 m w. 1 col.; 25 sup. nectoph.; 9 inf. nectoph.; 177 eudox.; 36 gonoph.
  - Y. 300 m w. 24 sup. nectoph.; 21 inf. nectoph.; 181 eudox.; 43 gonoph.
  - Y. 600 m w. 1 col.; 3 sup. nectoph.; 2 inf. nectoph.; 23 eudox.; 4 gonoph.; 6 fragm.
  - C. 3000 m w. 1 inf. nectoph.; 1 gonoph.
- St. 70. 39°06′ N., 9°47′ W. 4. III. 1909.
  - Y. 65 m w. 1 inf. nectoph.; 2 gonoph.
- St. 71. 39°35′ N., 9°45′ W. 4. III. 1909.
  - Y. 300 m w. 1 sup. nectoph.; 6 inf. nectoph.; 15 eudox.
- St. 87. 37°03′ N., 9°15′ W. 17. VI. 1910.
  - Y. 300 m w. 1 eudox.
- St. 89. 36°28′ N., 8°22′ W. 18. VI. 1910.
  - Y. 300 m w. 12 sup. nectoph.; 2 inf. nectoph.; 25 eudox.; gonoph.
  - Y. 1000 m w. 55 sup. nectoph.; 10 inf. nectoph.; 50 eudox.; 30 gonoph.
- St. 91. 35°53′ N., 7°26′ W. 18. VI. 1910.
  - Y. 300 m w. 69 sup. nectoph.; 66 eudox.; 159 bracts; 30 gonoph. (fragm.).
  - Y. 1600 m w. 1 col.; 7 sup. nectoph.; 4 inf. nectoph.; 16 eudox.; 15 gonoph.
- St. 92. 36°16′ N., 6°50′ W. 19. VI. 1910.
  - Y. 65 m w. 286 ± sup. nectoph.; 337 ± inf. nectoph.; 270 ± eudox.; 5 gonoph.[2].
- St. 93. 36°17′ N., 6°17′ W. 22. VI. 1910.
  - Y. 50 m w. 3 sup. nectoph.; 5 inf. nectoph.; 4 eudox.; 4 bracts.
- St. 94. 36°06′ N., 6°02′ W. 23. VI. 1910.
  - Y. 65 m w. 1 sup. nectoph.; 1 inf. nectoph.
- St. 95. 35°57′ N., 6°00′ W. 23. VI. 1910.
  - Y. 25 m w. 808 sup. nectoph.; 379 inf. nectoph.; 457 eudox.; 220 gonoph.
  - Y. 65 m w. 810 sup. nectoph.; 431 inf. nectoph.; 1202 eudox.; 184 gonoph.
  - Y. 300 m w. 3 sup. nectoph.; 5 inf. nectoph.; 3 eudox.; 8 bracts; 1 gonoph.
- St. 96. 35°48′ N., 5°58′ W. 23. VI. 1910.
  - Y. 65 m w. 4 sup. nectoph.; 4 inf. nectoph.; 5 bracts.
- St. 98. 35°57′ N., 5°35′ W. 23. VI. 1910.
  - Y. 65 m w. 860 sup. nectoph.; 625 inf. nectoph.; 1194 eudox.; 214 gonoph.; (100 fragm.).
- St. 99. 36°02′ N., 5°16′ W. 23. VI. 1910.
  - Y. 65 m w. 5 eudox.
- St. 106. 36°33′ N., 2°00′ W. 24. VI. 1910.
  - Y. 300 m w. 1 eudox.
- St. 108. 36°03′ N., 0°27′ W. 25. VI. 1910.
  - Y. 25 m w. 1 bract.
  - Y. 65 m w. 1 eudox.
- St. 112. 36°56′ N., 2°15′ E. 26. VI. 1910.
  - Y. 25 m w. 1 eudox.
  - Y. 65 m w. 1 sup. nectoph.
- St. 123. 44°14′ N., 8°55′ E. 2. VII. 1910.
  - Y. 25 m w. 1 eudox.
- St. 134. 37°37′ N., 10°17′ E. 15. VII. 1910.
  - Y. 25 m w. 3 sup. nectoph.; 1 inf. nectoph.; 1 eudox.
  - Y. 300 m w. 1 bract.
- St. 136. 37°01′ N., 10°31′ E. 19. VII. 1910.
  - Y. 25 m w. 1 inf. nectoph.
- St. 137. 37°17′ N., 10°56′ E. 19. VII. 1910.
  - Y. 25 m w. 4 sup. nectoph.; 4 inf. nectoph.
  - Y. 250 m w. 1 sup. nectoph.; 2 inf. nectoph.
- St. 138. 37°37′ N., 11°25′ E. 19. VII. 1910.
  - Y. 25 m w. 2 sup. nectoph.? (fragm.).
  - Y. 300 m w. 1 inf. nectoph.
  - Y. 1000 m w. 1 sup. nectoph.; 2 eudox.

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[1] For diagrams of bracts of Abylid eudoxids, see Totton, 1932, Fig. 17.

[2] Catches estimated after actually counting 0.19 and 0.29 of the tows at St. 92 (65 m wire) and St. 233 (25 m wire), respectively.

St. 142. 35°44′ N., 15°07′ E. 22. VII. 1910.
Y. 25 m w. 2 sup. nectoph.; 2 inf. nectoph.
St. 143. 35°18′ N., 16°25′ E. 23. VII. 1910.
Y. 1000 m w. 1 sup. nectoph.
St. 144. 34°31′ N., 18°40′ E. 24. VII. 1910.
Y. 25 m w. 4 sup. nectoph.; 1 inf. nectoph.; 2 bracts.
Y. 2000 m w. 1 sup. nectoph.; 1 inf. nectoph.
St. 145. 32°38′ N., 19°02′ E. 25. VII. 1910.
Y. 25 m w. 1 inf. nectoph.
Y. 300 m w. 1 inf. nectoph.; 1 eudox.
St. 147. 31°35′ N., 19°02′ E. 25. VII. 1910.
Y. 300 m w. 1 col.; 5 sup. nectoph.; 3 bracts.
Y. 1000 m w. 1 inf. nectoph.; 2 bracts.
St. 152. 33°11′ N.,21°44′ E. 27. VII. 1910.
Y. 25 m w. 2 inf. nectoph.; 1 bract.
Y. 300 m w. 4 sup. nectoph.; 1 inf. nectoph.; 2 bracts.
St. 156. 32°16′ N., 26°03′ E. 29. VII. 1910.
Y. 1000 m w. 2 sup. nectoph.; 1 inf. nectoph.
St. 158. 34°23′ N., 27°57′ E. 31. VII. 1910.
Y. 300 m w. 1 sup. nectoph.; 2 bracts.
St. 160. 35°59′ N., 28°14′ E. 1. VIII. 1910.
Y. 25 m w. 87 sup. nectoph.; 11 inf. nectoph.; 15 eudox.; 61 bracts.
Y. 300 m w. 1 col.; 2 sup. nectoph.; 1 inf. nectoph.; 2 bracts.
Y. 1000 m w. 1 sup. nectoph.; 1 eudox.
St. 161. 36°12′ N., 27°16′ E. 2. VIII. 1910.
Y. 25 m. 2 sup. nectoph.; 2 inf. nectoph.; 1 bract.
St. 163. 37°52′ N., 26°22′ E. 2. VIII. 1910.
Y. 25 m w. 37 col.; 527 sup. nectoph.; 134 inf. nectoph;. 114 eudox.; 473 bracts; 89 gonoph.
St. 179. 40°02′ N., 25°55′ E. 13. VIII. 1910.
Y. 65 m w. 11 bracts.
St. 181. 38°49′ N., 25°09′ E. 13. VIII. 1910.
Y. 65 m w. 2 col.; 12 sup. nectoph.; 11 inf. nectoph.
Y. 300 m w. 1 col.; 3 sup. nectoph.
St. 182. 38°13′ N., 24° 48′ E. 14. VIII. 1910.
Y. 65 m w. 2 sup. nectoph.; 3 inf. nectoph.; 2 bracts.
Y. 600 m w. 2 inf. nectoph.; 3 bracts.
St. 183. 37°52′ N., 23°09′ E. 16. VIII. 1910.
Y. 65 m w. 242 col.; 659 sup. nectoph.; 531 inf. nectoph.; 852 eudox.; 24 gonoph.
Y. 300 m w. 14 col.; 29 sup. nectoph.; 62 inf. nectoph.; 1 bract.
St. 208. 40°18′ N., 3°20′ E. 29. VIII. 1910.
Y. 25 m w. 1 gonoph.
St. 217. 38°01′ N., 1°48′ E. 1. IX. 1910.
Y. 300 m w. 1 eudox. (fragm.).
St. 221. 35°44′ N., 0°53′ W. 4. IX. 1910.
Y. 25 m. w. 1 inf. nectoph.
St. 229. 35°51′ N., 5°58′ W. 8. IX. 1910.
Y. 25 m w. 3 inf. nectoph.; 1 bract.
Y. 300 m w. 1 inf. nectoph.
St. 231. 35°56′ N. 7°16′ W. 8. IX. 1910.
Y. 25 m w. 33 col.; 402 sup. nectoph.; 764 inf. nectoph.; 948 eudox.; 121 bracts; 304 gonoph.; 103 fragm.
St. 232. 36°28′ N., 9°06′ W. 9. IX. 1910.
Y. 25 m w. 1 col.; 17 sup. nectoph.; 15 inf. nectoph.; 30 eudox. 1 gonoph.
Y. 300 m w. 6 col.; 6 sup. nectoph.; 9 inf. nectoph.
Y. 1000 m w. 2 inf. nectoph.
St. 233. 36°49′ N., 9°15′ W. 10. IX. 1910.
Y. 25 m w. 61 ± col.; 7562 ± sup. nectoph.; 7262 ± inf. nectoph.; 4207 ± eudox.; 2623 ± gonoph[1].
St. 234. 38°10′ N., 9°20′ W. 10. IX. 1910.
Y. 25 m w. 1 inf. nectoph.?
Y. 1000 m w. 1 eudox.
St. 296. 32°10′ N., 29°50′ E. 25. VI. 1911.
S. 28 m w. 1 inf. nectoph.
St. 341. 34°00′ N., 26°20′ E. 27. VIII. 1911.
S. 28 m w. 1 sup. nectoph.; 1 inf. nectoph.

Distinctive morphological characters of the superior nectophore, which resembles that of *Abylopsis* in the general arrangement of facets and ridges, are that the base of the hydroecium is not prolonged, as it is in the latter, and that the somatocyst lacks any trace of an apical diverticulum. The inferior nectophore stands alone, among the Abylinae, in that the wings of the hydroecium are fused to form a tube along the upper two thirds of the length of the bell, instead of remaining separate. MOSER (1925, p. 351) seems to have been the first specifically to emphasize (though many previous observers must have seen) the most striking feature of the nectophores and bracts of *Bassia;* namely, that the angles appear as white bands when seen on a black background, and as opaque-grayish or brownish ridges by transmitted light. So noticeable is this, that it is easy to detect even the most battered specimens at a glance. The fact that the basal angle of the right hydroecial wing of the inferior nectophore is prolonged as a prominent tooth seems also first to have been mentioned and pictured by her (MOSER, 1925, p. 351, Pl. 22, Fig. 3, 7). This is also shown in TOTTON's (1932, Fig. 18) drawing. HAECKEL's otherwise beautiful illustrations fail to show the notable asymmetry, in this respect, between the hydroecial wings.

Superior nectophores of this species are more resistant than the inferior ones, and many of the superiors in the "Thor" series are in good condition. But the inferiors are much battered, for which reason, they do not solve the question whether the suppressed ridge is the right lateral, as one of us has stated (BIGELOW, 1911 b, p. 230), or the median dorsal, as TOTTON (1932, p. 339) believes.

MOSER (1925), who gave the first detailed account of the radial subumbral canals of the inferior nectophore, describes them as grouped in two pairs, a dorsal, and a ventral, corresponding in radial location, to the four basal angles of the bell. TOTTON (1932, Fig. 18) shows them as similarly paired. But while MOSER states that the members of the ventral pair draw close together as they approach the ring canal, TOTTON shows them as continuing well apart, to their junction with the latter. Such of the inferior bells, in the "Thor" collection as are in good enough condition to show this feature, agree with MOSER's account in this respect. The great majority are too fragmentary to show the critical parts of all four of the canals clearly. In our experience, as in Browne's (1926, p. 65) routine preservation with formalin usually so softens and wrinkles the gelatinous substance of inferior bells of *Bassia* that the courses of the ridges and outlines of the basal angles and teeth are much distorted. This also applies to the bracts. Superior nectophores, on the other hand, preserve very well.

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[1] Catches estimated after actually counting 0.19 and 0.29 of the tows at St. 92 (65 m wire) and St. 233 (25 m wire), respectively.

## **CERATOCYMBINAE** Moser 1925.

## CERATOCYMBA Chun 1888.

### **CERATOCYMBA SAGITTATA** Quoy and Gaimard 1827.

*Cymba sagittata*, Quoy and Gaimard, 1827, p. 16, Pl. 2c, Fig. 1—9 (free Eudoxid).

*Diphyabyla hubrechti*, Lens and Van Riemsdijk, 1908, p. 36, Pl. 6, Fig. 47; Bigelow, 1911 b, p. 231, Pl. 12, Fig. 7.

For synonymy, see Bigelow, 1918, p. 411; Moser, 1925, p. 269.

Subsequent references are, *Ceratocymba sagittata*, Totton, 1925, p. 446; Browne, 1926, p. 65; Bigelow, 1931, p. 548; Leloup, 1933, p. 19; 1934, p. 54.

Material.

St. 62. 35°45′ N., 5°59′ W. 21. II. 1909.
Y. 25 m w. 1 sup. nectoph.
St. 64. 36°32′ N., 6°26′ W. 22. II. 1909.
Y. 25 m w. 1 eudox.
St. 65. 35°53′ N. 7°26′ W. 24. II. 1909.
Y. 600 m w. 1 sup. nectoph.; 3 inf. nectoph.
Y. 1600 m w. 1 sup. nectoph.
St. 66. 36°16′ N., 6°52′ W. 25. II. 1909.
Y. 25 m w. 1 sup. nectoph.
Y. 65 m w. 1 sup. nectoph.
St. 69. 36°13′ N., 9°44′ W. 28. II. 1909.
Y. 25 m w. 2 sup. nectoph.; 1 eudox.; 2 gonoph.
Y. 600 m w. 1 sup. nectoph.; 1 inf. nectoph.; 1 eudox.
St. 71. 39°35′ N., 9°45′ W. 4. III. 1909.
Y. 300 m w. 1 inf. nectoph.
St. 89. 36°28′ N., 8°22′ W. 18. VI. 1910.
Y. 65 m w. 1 eudox.
Y. 300 m w. 2 sup. nectoph.; 3 inf. nectoph.; 4 eudox.; 1 bract; 5 gonoph.
Y. 1000 m w. 2 gonoph.
St. 91. 35°53′ N., 7°26′ W. 18. VI. 1910.
Y. 300 m w. 3 sup. nectoph.; 14 eudox.; 27 gonoph.
Y. 1600 m w. 3 eudox..; 1 gonoph.; 1 inf. nectoph.
St. 94. 36°06′ N.,6°02′ W. 23. VI. 1910.
Y. 65 m w. 1 eudox.
St. 95. 35°57′ N., 6°00′ W. 23. VI. 1910.
Y. 300 m w. 1 bract; 1 gonoph.
St. 96. 35°48′ N., 5°58′ W. 23. VI. 1910.
Y. 65 m w. 4 bracts; 5 gonoph.
St. 98. 35°57′ N., 5°35′ W. 23. VI. 1910.
Y. 65 m w. 2 sup. nectoph.
St. 99. 36°02′ N., 5°16′ W. 23. VI. 1910.
Y. 300 m w. 1 eudox.; 1 gonoph.
St. 232. 36°28′ N., 9°06′ W. 9. IX. 1910.
Y. 300 m w. 1 bract.
Y. 1000 m w. 3 sup. nectoph.; 1 inf. nectoph.

The superior nectophores, made recognizable at a glance, among abylids, by their high-pyramidal outline, have been pictured by Lens and Van Riemsdijk (1908), by Moser (1925), and by Bigelow (1911 b, Pl. 12, Fig. 7). The largest superior nectophore in the "Thor" series is 29 mm. long. Up to the present, no complete colonies have been seen, with both bells still connected; nor are there any in the "Thor" collection. But the inferiors described and figured by Bigelow (1918, p. 413, Pl. 7, Fig. 1) and by Moser (1925, p. 275, Pl. 15, Figs. 1, 4, Pl. 16, Fig. 1) seem almost certainly to belong to this species, not only because taken side by side with the superior bells, but also because of their large size, of their strongly diagnostic characters (see below), and of their resemblance to the gonophores of this species. Like the inferior bells of *Abyla trigona*, they are triangular in cross section above the midlevel. In *Ceratocymba*, however, as in *Abyla leuckartii*, it is the upper part of the dorsal ridge which is suppressed, whereas it is the upper part of the right lateral in *trigona*. *Ceratocymba* is, however, sharply separated from *A. leuckartii* by the fact that the right ventro-basal corner of the inferior bell of the former is prolonged into a tooth that is much longer than either the dorsal or the lateral teeth, whereas the left ventro-basal corner is but little more than rectangular. The asymmetry is, in fact, much more pronounced in this respect, in *Ceratocymba* than in any other abylid so far known[1]. Altogether, the "Thor" series contains 8 inferiors, of this type, ranging in length up to 33 mm.

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[1] The inferior nectophores of all known abylids have been described, except that of *A. haeckeli*, the superior bell of which so closely resembles that of *A. trigona* that the parallelism will probably be found to extend to the inferior as well.

Superior and inferior bells of this species are so large, so resistant, and so easily recognized, that the foregoing list no doubt includes all that were taken. It is, therefore, interesting that there are more than twice as many superiors as inferiors, the numbers being equal in only one haul. This suggests that the bells are easily separated, and that after separation — perhaps by waves — the inferiors soon perish, as might, indeed, be expected. On the other hand, the superiors often continue attached to the stem, and hence are enabled to survive. The stems, in one superior nectophore in the "Bache" collection, bore one cormidium with a male gonophore far enough advanced to show its definitive characters (Bigelow, 1918, Pl. 6, Fig. 1, 2). And it is on the basis of this that the free eudoxids with gonophores attached, and loose gonophores are identified as this species. The gonophores show the same type of asymmetry as the inferior nectophores, but the two sexes are mirror images, one of the other in this respect, it being the right basoventral tooth that is prolonged in the male, the left hand in the female as Moser (1912a) first pointed out. For illustrations of the gonophores, see Bigelow, 1918, Pl. 6, Fig. 2, 3; Pl. 7, Fig. 2, 3; Moser, 1925, Pl. 16, Fig. 3, 5.

The identity of the loose bracts listed above seems equally assured, both by the fact that they were taken together with *sagittata* gonophores and that the collection did not contain any examples (nectophores or eudoxids) of *Abyla leuckartii*, which is the only known species with which they could be confused.

According to Moser (1913a; 1925, p. 289), the bracts of *C. sagittata* and *A. leuckartii* are in fact so much alike that they are indistinguishable when detached. But, as elsewhere pointed out (Bigelow, 1918, p. 414, Pl. 5, Fig. 5; 1931, p. 549), the left lateral ridge of the bract of *C. sagittata* (identity proven by the gonophore), fails to reach the left apical ridge, whereas it reached the latter in the only *A. leuckartii*, of proven identity[1], seen by us. And as this is also true of all of the eudoxids listed above (except for a few that are too damaged to show the ridge at all), and likewise for such of the loose bracts as are in good condition, it seems that it is a reliable specific criterion. This also applies to the contour of the apical facet of the bract which is deeply concave and triangular in all the "Thor" specimens, as it was the "Bache" series (Bigelow, 1918, p. 414, Pl. 5, Fig. 5). This contrasts so strongly with the flat or slightly convex and quadrangular apical facet of the bract of *A. leuckartii* as to make identification possible for specimens the condition of which does not allow detection of the point of termination of the left lateral ridge.

## GALETTINAE Stechow 1921.

Totton (1932, p. 340) followed by Leloup (1933, p. 25) has shown what one of us (Bigelow, 1931) had overlooked, that abandonment of *Galeolaria* as the generic name for siphonophores because preoccupied for a worm as Stechow (1921) pointed out, necessitates the resurrection of *Sulculeolaria*, Blainville (1834) with *S. quadrivalvis* Blainville (1834) as the type. Whether *Galetta*, proposed by Stechow (1921) to replace *Galeolaria* as a siphonophore-name, becomes a synonym of *Sulculeolaria*, depends on whether absence of basal teeth in its type species (*G. australis*, Quoy and Gaimard 1834) contrasted with their presence in *Sulculeolaria quadrivalvis*, is sufficient difference for generic separation. Totton recognizes both genera, *Sulculeolaria* for toothed Galettinae, *Galetta* for the toothless species. And this course is followed here, as by Leloup (1933, 1934).

## SULCULEOLARIA Blainville 1830[2].

Recent studies by Browne (1926, p. 66), by Totton (1932, p. 340), and by Bigelow (1918, p. 415; 1931, p. 549) indicate that the three named forms referable to *Sulculeolaria* as now limited, *quadrivalvis* Blainville, *quadridentata* Quoy & Gaimard and *monoica* Chun, represent as many good species, the first having only two, the second four basal teeth in the superior nectophore, and the third three teeth (1 dorsal, 2 dorso-lateral) besides a projecting lappet on each side. MOSER (1925, p. 142) on the other hand does not consider the dentition a reliable specific character in this group, on the ground that "Abweichungen in der Bildung der Mundzähne sind häufig". She therefore united all the early references to the quadridentate as well as to the bidentate form[1], under the synonymy of *quadrivalvis*. LELOUP (1932, p. 5) also definitely unites *quadridentata* with *quadrivalvis*, and MOSER (1925, p. 142, 145) even suggests that *monoica* may on this same ground prove to be only a variety of *quadrivalvis*, though she still retains it in her system, as a distinct species.

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[1] Identified by the gonophore.

[2] For the history of this generic name see Totton (1932, p. 340). Moser (1925, p. 135) dates it from "Lesueur, Manuskript, 1807". But manuscript names have no standing, by the International Rules of Zoological Nomenclature.

The early history of *quadrivalvis* and of *quadridentata* is summarized elsewhere (BIGELOW, 1931, p. 550). The existence of the two alternate forms, bidentate and quadridentate, was not clearly recognized until 1918, when QUOY and GAIMARD's old name *quadridentata*, was revived for the latter (BIGELOW, 1918, p. 417, Pl. 8, Fig. 1). Since that time, BROWNE (1926), LELOUP (1933, p. 26) and BIGELOW (1931, Fig. 201) have not only had specimens with large lateral teeth, as well as the two dorsals (as had MOSER, also), but have likewise found among specimens with only two large teeth (the dorsal), occasional examples with projecting baso-lateral angles, or incipient teeth (TOTTON, 1932, Fig. 19A; LELOUP, 1932, Fig. 1A; BIGELOW, 1931, Fig. 197). But these have been greatly outnumbered, among primarily bidentate specimens, by those in which the latero-basal margin is not so interrupted (TOTTON, 1932, Fig. 19C; LELOUP, 1932, Fig. 1B; BIGELOW, 1931, Fig. 195, 196). TOTTON's and BIGELOW's series combined (a total of 47 specimens) were distributed as follows:— 33 with baso-lateral angles uninterrupted (typical *quadrivalvis*); 2, with slightly projecting baso-lateral eminences; 12, with rudimentary triangular lateral teeth; much smaller, however, than the 2 dorsal teeth as previously illustrated (TOTTON, 1932, Fig. 19A; BIGELOW, 1931, Fig. 197). In none of these, however, nor in the specimen illustrated by LELOUP, did the lateral teeth approach those of the typically quadridentate form in size. The gap between the latter, and the extreme variants of the bidentate form has not yet been bridged by actual observation. Neither does the "Thor" series add any evidence in that direction, for while all are more or less damaged, it has been possible to classify all the superior nectophores of *Sulculeolaria* either as definitely quadridentate, or as bidentate.

On the other hand, no criterion has yet been found to separate the inferior nectophores of the two forms. And this is admittedly a strong argument for uniting them specifically, because it is decidedly exceptional for species of Calycophorae which differ in the conformation of the superior nectophore, to show no differences in the inferior.

It was formerly believed that the colonies of *Sulculeolaria* were unisexual as early described by GEGENBAUR (1853, p. 108), VOGT (1854, p. 112) and WEISMANN (1883, p. 199). NEPPI's (1921) discovery of a specimen in which the most distal gonophore was a male, but the more proximal gonophores were female, suggests, on the contrary, that *Sulculeolaria* actually is monoecious, with gonophores of one sex developing first, the other sex afterward. Unfortunately, none of the specimens we have seen throw any light on the point. And it does not necessarily follow that, if one specimen be protandrous, the sexual succession may not be the reverse, in others. The possibility that the alternate states of the superior nectophore — bidentate and quadridentate — may be a sexual character, not a specific one, must therefore be considered. VOGT (1854, p. 112) remarks, it is true, that the nectophores of the two sexes are alike, but his account of the base of the superior nectophore is not satisfactory. GEGENBAUR does not comment on this point, nor has any more recent author. And while WEISMANN (1883) states that the 10 colonies he obtained at Naples were all of one sex (female), he gives no account of the nectophores.

The only specimens we have seen, with stems still intact, are two *quadridentata* from Naples, both of which bear a continuous series of female gonophores, and one lot (three) of bidentate specimens, from the Eastern Tropical Pacific. When dipped up from the surface (BIGELOW, 1911b, p. 237), the latter had the stems attached, and were so preserved. But their stems became detached in transit. On examination it proved

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[1] MOSER seems not to have seen the re-description of *quadridentata* from the "Bache" collection (BIGELOW, 1918, p. 417).

(Bigelow, 1911b, Pl. 5, Fig. 6, 7) that both sexes were represented among the three, a fact verified on reexamination. But as the stems are not only detached, but fragmented, it is impossible to determine whether there were two male and one female specimen, or vice versa. However this may be, observation thus makes it certain that the bidentate form occurs in both sexes. Hence it may be assumed that this applies equally to the quadridentate, though it happens that the only colonies of the latter of which the sex has been definitely determined, chanced to be females.

This evidence does not, of course, forbid the possibility that the quadridentate form is a sport that appears more often in female than in male colonies. But as there is no evidence of this (it seems at the best unlikely), it seems wisest to retain two species, at least for the time being. In this way the alternate or joint regional occurrence of the two will be emphasized instead of obscured, and the need for more critical examination of the question will be kept to the fore.

Superior nectophores of *Sulculeolaria* are therefore listed here, under the two species. All inferiors taken in the tows are listed as belonging to "*S. quadridentata* or *quadrivalvis*".

Reasons for regarding *monoica*, also, as a good species are given elsewhere (Bigelow, 1931, p. 559). It is separated from the *quadrivalvis-quadridentata* group, not only by the dentition of the superior nectophore, but also by the fact that the inferior nectophore has three dorsal teeth, projecting lateral angles, and an undivided ventral wing, whereas the *quadrivalvis-quadridentata* group have 4 teeth (2 dorsal, and a lateral on each side) and a divided wing in the inferior nectophore.

Recent records of *monoica* are by Browne (1926, p. 69) and by Totton (1932, p. 342), who have commented on the dentition; also by Leloup (1932, p. 3; 1933, p. 25) and by Bigelow (1931, p. 558).

## **SULCULEOLARIA QUADRIDENTATA** Quoy and Gaimard 1834.

*Galeolaria quadridentata*, Quoy and Gaimard, 1834, p. 45, Pl. 5, Figs. 32, 33.

Positive references to this species are:—

*Diphyes quadrivalvis*, Keferstein and Ehlers, 1861, p. 18, Pl. 5, Fig. 26E.
*Galeolaria auriantiaca*, Lochman, 1914, p. 262, Pl. 7, Fig. 1—3.
*Galeolaria quadridentata*, Bigelow, 1918, p. 417, Pl. 8, Figs. 1—2; Browne, 1926, p. 67.
*Galeolaria quadrivalvis* (partim), Moser, 1925, p. 139; Leloup, 1932, p. 4.
*Galetta quadridentata*, Bigelow, 1931, p. 556, Text-figs. 201—203.
*Sulculeolaria quadridentata*, Totton, 1932, p. 340.
*Sulculeolaria quadrivalvis* (partim), Leloup, 1933, p. 26.

### Material.

St. 63. 35°50′ N., 6°03′ W. 22. II. 1909.
  Y. 25 m w. 1 sup. nectoph.
St. 65. 35°53′ N., 7°26′ W. 24. II. 1909.
  Y. 65 m w. 2 sup. nectoph.
St. 66. 36°16′ N., 6°52′ W. 25. II. 1909.
  Y. 300 m w. 1 sup. nectoph.
St. 69. 36°13′ N., 9°44′ W. 28. II. 1909.
  Y. 25 m w. 2 sup. nectoph.
  Y. 600 m w. 2 sup. nectoph.
St. 86. 37°22′ N., 9°15′ W. 17. VI. 1910.
  P. Surface. 2 sup. nectoph.
St. 112. 36°56′ N., 2°15′ E. 27. VI. 1910.
  Y. 25 m w. 1 sup. nectoph.
St. 115. 38°17′ N., 4°11′ E. 28. VI. 1910.
  Y. 25 m w. 1 sup. nectoph.
  Y. 65 m w. 1 sup. nectoph.
St. 130. 39°35′ N., 11°20′ E. 13. VII. 1910.
  Y. 25 m w. 37 sup. nectoph.
St. 131. 38°36′ N., 11°00′ E. 13. VII. 1909.
  Y. 25 m w. 1 sup. nectoph.
St. 133. 38°18′ N., 9°59′ E. 14. VII. 1910.
  Y. 25 m w. 4 sup. nectoph.
St. 137. 37°17′ N., 10°56′ E. 19. VII. 1910.
  Y. 25 m w. 16 sup. nectoph.
  Y. 250 m w. 2 sup. nectoph.
St. 138. 37°37′ N., 11°25′ E. 19. VII. 1910.
  Y. 25 m w. 1 sup. nectoph.
St. 144. 34°31′ N., 18°40′ E. 23. VII. 1910.
  Y. 25 m w. 3 sup. nectoph.
St. 145. 32°38′ N., 19°02′ E. 25. VII. 1910.
  Y. 25 m w. 3 sup. nectoph.
St. 156. 32°16′ N., 26°03′ E. 30. VII. 1910.
  Y. 25 m w. 1 sup. nectoph.
St. 182. 38°13′ N., 24°48′ E. 14. VIII. 1910.
  Y. 65 m w. 1 sup. nectoph.
St. 183. 37°52′ N., 23°09′ E. 16. VIII. 1910.
  Y. 65 m w. 3 sup. nectoph.
St. 186. 37°57′ N., 19°51′ E. 17. VIII. 1910.
  Y. 10 m w. 1 sup. nectoph.

St. 189. 37°44′ N., 15°58′ E. 19. VIII. 1910.
Y. 25 m w. 1 sup. nectoph.
Y. 1000 m w. 1 sup. nectoph.
St. 192. 38°07′ N., 15°35′ E. 20. VIII. 1910.
Y. 25 m w. 5 sup. nectoph.
Y. 600 m w. 1 sup. nectoph.
St. 194. 38°33′ N., 15°29′ E. 21. VIII. 1910.
Y. 10 m w. 2 sup. nectoph.
Y. 25 m w. 1 sup. nectoph.
St. 196. 39°59′ N., 14°31′ E. 22. VIII. 1910.
Y. 25 m w. 13 sup. nectoph.
St. 199. 39°32′ N., 10°49′ E. 25. VIII. 1910.
Y. 25 m w. 3 sup. nectoph.
Y. 300 m w. 1 sup. nectoph.
Y. 1000 m w. 2 sup. nectoph.
St. 202. 38°59′ N., 9°25′ E. 26. VIII. 1910.
Y. 300 m w. 3 sup. nectoph.
St. 204. 38°52′ N., 7°43′ E. 27. VIII. 1910.
Y. 25 m w. 8 sup. nectoph.
Y. 65 m w. 4 sup. nectoph.
Y. 300 m w. 1 sup. nectoph.
Y. 1000 m w. 1 sup. nectoph.
St. 206. 39°32′ N., 5°15′ E. 28. VIII. 1910.
Y. 1000 m w. 1 sup. nectoph.
Y. 2000 m w. 1 sup. nectoph.
St. 208. 40°18′ N., 3°20′ E. 29. VIII. 1910.
Y. 25 m w. 2 sup. nectoph.
St. 209. 40°34′ N., 3°03′ E. 29. VIII. 1910.
Y. 25 m w. 6 sup. nectoph.
C. 150 m w. 1 sup. nectoph.
St. 215. 39°14′ N., 0°52′ E. 31. VIII. 1910.
Y. 25 m w. 1 sup. nectoph.
St. 216. 38°31′ N., 1°24′ E. 1. IX. 1910.
Y. 25 m w. 3 sup. nectoph.

This list includes all the superior nectophores of *Sulculeolaria* which have large latero-basal teeth. Since recent collections have yielded fewer superior nectophores of *quadridentata* than *quadrivalis* (the "Arcturus" series contained only 2 of the former to 32 of the latter), it is interesting that the relative proportions of the two in the "Thor" collection are reversed.

In every case, all but the basal attachment of the stem has been lost, hence the material adds nothing to the earlier accounts of reserve buds or of stem groups (Bigelow, 1931, p. 556), which agree in every respect with those of *S. quadrivalvis*, so far as can be seen from a comparison of excellent specimens of the latter both from the Pacific and from the Atlantic (Bigelow, 1911 b, Pl. 5, Figs. 5—7; 1931, p. 553, Figs. 198—200) with *quadridentata* from Naples (Bigelow, 1931, p. 556, Figs. 201—203).

## SULCULEOLARIA QUADRIVALVIS Blainville 1830.

*Sulculeolaria quadrivalvis*, Blainville, 1830, p. 126; 1834, p. 138, Pl. 6, Fig. 6.

References, prior to 1918, which certainly apply to *S. quadrivalvis* as distinguished from *quadridentata* are:—

*Diphyes quadrivalvis*, Gegenbaur, 1853 a, p. 315, 449, Pl. 16, Figs. 8—11.

*Galeolaria filiformis*, Leuckart, 1854, p. 280, Pl. 11, Figs. 14—17.

*Galeolaria aurantiaca*, Vogt, 1854, p. 110, Pl. 18—20.

The following notices published since the rediscovery of *S. quadridentata* (Bigelow, 1918) also refer wholly or in part to *quadrivalvis*.

*Galeolaria quadrivalvis*, Bigelow, 1919, p. 336; Moser, 1925, p. 139 (partim); Browne, 1926, p. 66; Leloup, 1932, p. 4 (partim).

*Galetta quadrivalvis*, Bigelow, 1931, p. 549.

*Sulculeolaria quadrivalvis*, Totton, 1932, p. 341; Leloup, 1933, p. 26 (partim).

For many other references, which may apply to either or to both species, see the bibliography given by Moser (1925, p. 139).

Material:

St. 137. 37°17′ N., 10°56′ E. 19. VII. 1910.
Y. 25 m w. 1 sup. nectoph.
St. 194. 38°33′ N., 15°29′ E. 21. VIII. 1910.
Y. 25 m w. 1 sup. nectoph.
St. 207. 39°58′ N., 3°41′ E. 28. VIII. 1910.
Y. 65 m w. 1 sup. nectoph.

These few bells are all more or less fragmentary, but all show the bidentate conformation (p. 30). As the stems have been lost, they add nothing to earlier accounts of the reserve bells or stem groups (for a recent discussion and illustrations of the reserve bells, of the mode of attachment of the siphons to the stem and of the conformation of the gonophores, see Bigelow, 1931, p. 553).

## Inferior Nectophores of
## SULCULEOLARIA QUADRIVALVIS and QUADRIDENTATA.

### Material.

St. 63. 35°50′ N., 6°03′ W. 22. II. 1909.
 Y. 25 m w. 1 inf. nectoph.
St. 65. 35°53′ N., 7°26′ W. 24. II. 1909.
 Y. 65 m w. 3 inf. nectoph.
St. 69. 36°13′N., 9°44′ W. 28. II. 1909.
 Y. 25 m w. 1 inf. nectoph.
 Y. 600 m w. 1 inf. nectoph.
St. 86. 37°22′ N., 9°15′ W. 17. VI. 1910.
 P. Surface. 2 inf. nectoph.
St. 106. 36°33′ N., 2°00′ W. 25. VI. 1910.
 Y. 300 m w. 1 inf. nectoph.
St. 112. 36°56′ N., 2°15′ W. 27. VI. 1910.
 Y. 25 m w. 1 inf. nectoph.
St. 115. 38°17′ N., 4°11′ E. 28. VI. 1910.
 Y. 65 m w. 1 inf. nectoph.
St. 130. 39°35′ N., 11°20′ E. 13. VII. 1910.
 Y. 25 m w. 60 inf. nectoph.
St. 131. 38°36′ N., 11°00′ E. 13. VII. 1910.
 Y. 25 m w. 2 inf. nectoph.
St. 133. 38°18′ N., 9°56′ E. 14. VII. 1910.
 Y. 300 m w. 1 inf. nectoph.
St. 134. 37°37′ N., 10°17′ E. 15. VII. 1910.
 Y. 25 m w. 3 inf. nectoph.
St. 137. 37°17′ N., 10°56′ E. 19. VII. 1910.
 Y. 25 m w. 17 inf. nectoph.
 Y. 250 m w. 6 inf. nectoph.
St. 141. 36°42′ N., 13°34′ E. 20. VII. 1910.
 Y. 25 m w. 1 inf. nectoph.
St. 144. 34°31′ N., 18°40′ E. 23. VII. 1910.
 Y. 25 m w. 4 inf. nectoph.
St. 145. 32°38′ N., 19°02′ E. 25. VII. 1910.
 Y. 25 m w. 3 inf. nectoph.
St. 156. 32°16′ N., 26°03′ E. 30. VII. 1910.
 Y. 25 m w. 1 inf. nectoph.
St. 183. 37°52′ N., 23°09′ E. 16. VIII. 1910.
 Y. 300 m w. 2 inf. nectoph.
St. 186. 37°57′ N., 19°51′ E. 17. VIII. 1910.
 Y. 10 m w. 3 inf. nectoph.
St. 189. 37°44′ N., 15°58′ E. 19. VIII. 1910.
 Y. 300 m w. 2 inf. nectoph.
 Y. 1000 m w. 1 inf. nectoph.
St. 192. 38°07′ N., 15°35′ E. 20. VIII. 1910.
 Y. 25 m w. 10 inf. nectoph.
St. 194. 38°33′ N., 15°29′ E. 21. VIII. 1910.
 Y. 10 m w. 2 inf. nectoph.
 Y. 25 m w. 2 inf. nectoph.
St. 196. 39°59′ N., 14°31′ E. 22. VIII. 1910.
 Y. 25 m w. 6 inf. nectoph.
St. 199. 39°32′ N., 10°49′ E. 25. VIII. 1910.
 Y. 25 m w. 3 inf. nectoph.
 Y. 300 m w. 1 inf. nectoph.
 Y. 1000 m w. 2 inf. nectoph.
St. 202. 38°59′ N., 9°25′ E. 26. VIII. 1910.
 Y. 300 m w. 3 inf. nectoph.
St. 204. 38°52′ N., 7° 43′ E. 27. VIII. 1910.
 Y. 25 m w. 6 inf. nectoph.
 Y. 65 m w. 7 inf. nectoph.
 Y. 300 m w. 1 inf. nectoph.
St. 206. 39°32′ N., 5°15′ E. 28. VIII. 1910.
 Y. 1000 m w. 2 inf. nectoph.
 Y. 2000 m w. 1 inf. nectoph.
St. 207. 39°58′ N., 3°41′ E. 28. VIII. 1910.
 Y. 65 m w. 1 inf. nectoph.
St. 208. 40°18′ N., 3°20′ E. 29. VIII. 1910.
 Y. 25 m w. 2 inf. nectoph.
St. 209. 40°34′ N., 3°03′ E. 29. VIII. 1910.
 Y. 25 m w. 5 inf. nectoph.
 C. 150 m w. 3 inf. nectoph.
St. 215. 39°14′ N., 0°52′ E. 31. VIII. 1910.
 Y. 25 m w. 2 inf. nectoph.
St. 216. 38°31′ N., 1°24′ E. 1. IX. 1910.
 Y. 25 m w. 2 inf. nectoph.
St. 223. 36°13′ N., 1°28′ E. 5. IX. 1910.
 Y. 25 m w. 2 inf. nectoph.
St. 277. 33°20′ N., 27°30′ E. 6. IV. 1911.
 P. 132 m w. 2 inf. nectoph.

In the above list are included all the inferior nectophores belonging either to *S. quadridentata* or to *S. quadrivalvis*, since they were all detached from their superior nectophores and, hence, were indistinguishable.

## GALETTA Stechow 1921.

It is still doubtful how many species are represented by the known members of this genus, the chief difficulty being that no recent student has had specimens certainly identifiable as the species first described by Gegenbaur (1854), as *Diphyes turgida*. Gegenbaur, and also Sars (1857) described this as lacking a somatocyst, and Gegenbaur's (1854, p. 443) characterization of the basal lamella of the superior nectophore as "abgerundete" suggests that the wing is undivided. For any diphyid actually to lack a somatocyst would be so exceptional, that several authors — most recently Candeias (1929, p. 273) and Leloup (1933, p. 27) — have suggested that this organ may have been overlooked by Gegenbaur. Totton (1932, p. 345) has, in fact, referred Australian specimens with "very small somatocysts" to *turgida*, but without stating whether their basal lamellae were divided or undivided, or describing the canalization. It is also pertinent that both Candeias (1929, p. 272) and Leloup have recently reported specimens of *G. australis* (i. e., with divided basal lamellae) with minute somatocysts. Leloup (1933, p. 27), in particular, speaks of a specimen which had a "somatocyste minuscule qui forme à peine une boursouflure dans le canal gastrovasculaire". Several of the *australis* we have seen also have extremely minute somatocysts. But while specimens not in the best of condition often show no trace of the latter, a somatocyst has been detectable, even if minute, in every good example that we have seen.

Quite apart from the question of the presence or absence of the somatocyst, Gegenbaur's (1854) *turgida*, would stand alone among the known Galettas if the basal lamella of the superior nectophore actually was not divided.

Lack of critical information as to the growth stages, as to the limits of variation in the length of the somatocyst, as to the outlines of the hydroecial sector of the base of the superior nectophore, and as to the regularity with which a commissural canal is present, similarly complicate our decision as to whether the Galettas with a divided basal wing in the superior nectophore all fall within the old species *G. australis*, or whether *G. chuni* Lens and Van Riemsdijk, and *G. meteori* Leloup are recognizable species.

According to the original description, *chuni* is characterized by lacking commissural canals in the superior nectophore[1], as well by its very large somatocyst. And Moser (1925, p. 150) has subsequently reported as *G. chuni* a considerable series, showing similarly simple canalization and large somatocysts. Recently, Totton (1932, p. 342) has recorded small superior bells from Australia, with long somatocysts, and lacking commissural canals, as *chuni*. However, among thirteen superior nectophores with large somatocysts reported by Browne under this name, eight showed "a *Diphyes* type of canal system and three the normal *Galeolaria* type" (Browne, 1926, p. 70). This, with the evidence given below (p. 36), points to such a wide variability in the presence or absence of the commissural canal, that this character cannot safely be used as specific; leaving only the very long somatocyst as diagnostic of *chuni*. And as the contrast so far reported in this respect between it and *australis* is wide, it seems that earlier reference of *chuni* to the synonymy of *australis* (Bigelow, 1911 b) was premature, though its status certainly requires further investigation.

*G. meteori* Leloup (1934) resembles *australis* in the shortness of the somatocyst, but differs from it in the depth of the hydroecial indentation of the base, in the fact that this involves the ventral margin of the bell for a considerable distance above the level of the mouth of the nectosac (only the superior bell is known), and in the narrowness of the basal sector between the opening of the nectosac and the ventral margin. But as the largest of Leloup's series was only 4 mm. long, it may perhaps prove to be the young of *australis*. At any rate, its status needs farther investigation.

As the matter now stands, the superior bells of *Galetta* may be grouped as follows:—

Basal wing divided:
    Somatocyst not reaching more than $^1/_3$ the length of the nectosac, and often minute: possibly even absent in some specimens
        Baso-ventral sector broad; no definite hydroecial indentation .................................. *australis*
        Baso-ventral sector very narrow; a well marked hydroecial furrow....... *meteori* (perhaps a growth stage of *australis*)
    Somatocyst reaching well above mid-level of nectosac .................................................. *chuni*
Basal wing undivided; no somatocyst .............................. *turgida* (status somewhat doubtful)

It is not yet possible to state precise criteria for specifically identifying the inferior nectophores of the several species of *Galetta*. The case is, in fact, worse than for the superior bells. In all of them (except for *meteori*, the lower bell of which is not yet known) the ventral wing is undivided. But considerable variation has been recorded from a simply rounded to a definitely notched basal contour, among inferior bells taken side by side with superiors both of *chuni* and of *australis*. To judge from Moser's (1925, Pl. 3, Fig. 4) and Totton's (1932, p. 343, Fig. 20, B, D) drawings, the hydroecial wings of *chuni* do not show the sudden increase in breadth toward the superior end of the bell which is characteristic of *australis* (Bigelow 1911 b, Pl. 5, Fig. 9; Pl. 6, Fig. 3). Moser (1925, p. 154) likewise describes the ventral lamella as very short. But her own figures (Pl. 3, Fig. 3, 4) show little difference in this respect between *australis* and *chuni*, while Totton found it fully as long in the latter as it is in *australis*. And Gegenbaur's (1854) illustration of the lower bell of *G. turgida* is not detailed enough for critical comparison.

The better preserved examples of *australis* among those we have seen — Atlantic as well as Pacific —

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[1] Lens and Van Riemsdijk's illustration (Pl. 9, Fig. 79) shows commissural canals, however.

show at least some trace of the lateral wings. The basal contour-line of the undivided ventral wing when intact, shows a more or less pronounced duplex curve (Bigelow, 1911 b, Pl. 5, Fig. 9), which may prove to be diagnostic, as the wing is simply notched or even rounded in *chuni* according to Totton's (1932, Fig. 20) and Moser's (1925, Pl. 3, Fig. 4) drawings. Unfortunately, the ventral wing is so easily damaged that its normal contour is traceable only in unusually well preserved specimens[1].

## GALETTA AUSTRALIS Quoy and Gaimard 1834.

Fig. 26.

*Galeolaria australis*, Quoy and Gaimard, 1834, p. 43, Pl. 5, Figs. 30—31.

For synonymy, see Moser, 1925, p. 145.

More recent references which can be positively referred to this species (p. 34) are:—

*Galeolaria australis*, Bigelow, 1918, p. 419; Browne, 1926, p. 67 (partim); Candeias, 1929, p. 273, text-figs. 2—6; Leloup, 1932, p. 6.

*Galetta australis*, Bigelow, 1931, p. 559, text-figs. 204—207; Leloup, 1933, p. 26; 1934, p. 15.

### Material.

St. 10. 37°21′ N., 16°45′ E. 15. XII. 1908.
Y. 65 m w. 6 sup. nectoph.; 3 inf. nectoph.
St. 11. 36°57′ N., 18°16′ E. 16. XII. 1908.
Y. 25 m w. 21 sup. nectoph.; 30 inf. nectoph.
St. 24. 40°14′ N., 12° 23′ E. 16. I. 1909.
Y. 65 m w. 1 sup. nectoph.; 1 inf. nectoph.
St. 36. 42°49′ N., 6°54′ E. 30. I. 1909.
Y. 65 m w. 1 sup. nectoph.; 1 inf. nectoph.
St. 39. 39°41′ N., 10°02′ E. 1. II. 1909.
Y. 65 m w. 1 inf. nectoph.
St. 46. 37°17′ N., 6°00′ E. 7. II. 1909.
Y. 65 m w. 1 inf. nectoph.
St. 47. 36°55′ N., 3′12′ E. 10. II. 1909.
Y. 65 m w. 1 sup. nectoph.; 1 inf. nectoph.
St. 65. 35°53′ N., 7° 26′ W. 24. II. 1909.
Y. 25 m w. 1 sup. nectoph.; 1 inf. nectoph.
Y. 65 m w. 1 sup. nectoph.
Y. 300 m w. 1 sup. nectoph.
St. 69. 36°13′ N., 9°44′ W. 28. II. 1909.
Y. 65 m w. 1 sup. nectophore; 1 inf. nectoph.
Y. 300 m w. 2 sup. nectoph.; 3 inf. nectoph.
St. 80. 46°17′ N., 7°31′ W. 13. VI. 1910.
Y. 300 m w. 1 inf. nectoph.
St. 91. 35°53′ N., 7°26′ W. 18. VI. 1910.
Y. 1600 m w. 2 sup. nectoph.; 2 inf. nectoph.
St. 95. 35°57′ N., 6°00′ W. 23. VI. 1910.
Y. 25 m w. 1 inf. nectoph.
St. 106. 36°33′ N., 2°00′ W. 25. VI. 1910.
Y. 300 m w. 1 inf. nectoph.
St. 115. 38°17′ N., 4°11′ W. 29. VI. 1910.
Y. 25 m w. 8 sup. nectoph.; 10 inf. nectoph.
Y. 65 m w. 7 inf. nectoph.
Y. 2000 m w. 3 sup. nectoph.; 2 inf. nectoph.
St. 116. 39°27′ N., 5°26′, 30. VI. 1910.
Y. 25 m w. 4 sup. nectoph.; 4 inf. nectoph.
Y. 65 m w. 3 sup. nectoph.; 3 inf. nectoph.
Y. 300 m w. 2 sup. nectoph.; 3 inf. nectoph.
St. 118. 41°00′ N., 6°43′ E. 30. VI. 1910.
Y. 25 m w. 1 sup. nectoph.
Y. 65 m w. 2 sup. nectoph.; 2 inf. nectoph.
Y. 300 m w. 6 sup. nectoph.; 9 inf. nectoph.
St. 123. 44°14′ N., 8°55′ E. 3. VII. 1910.
Y. 25 m w. 2 inf. nectoph.
St. 129. 40°05′ N., 11°31′ E. 12. VII. 1910.
Y. 25 m w. 9 sup. nectoph.; 18 inf. nectoph.
Y. 300 m w. 1 inf. nectoph.
Y. 600 m w. 1 inf. nectoph.
St. 130. 39°35′ N., 11°20′ E. 13. VII. 1910.
Y. 25 m w. 18 sup. nectoph.; 41 inf. nectoph.
St. 132. 38°57′ N., 9°47′ E. 14. VII. 1910.
Y. 25 m w. 13 sup. nectoph.; 21 inf. nectoph.
Y. 300 m w. 1 inf. nectoph.
St. 133. 38°18′ N., 9°59′ E. 14. VII. 1910.
Y. 25 m w. 6 sup. nectoph.; 4 inf. nectoph.
St. 134. 37°37′ N., 10°17′ E. 15. VII. 1910.
Y. 25 m w. 1 sup. nectoph.; 4 inf. nectoph.
Y. 300 m w. 2 inf. nectoph.
St. 138. 37°37′ N., 11°25′ E. 19. VII. 1910.
Y. 25 m w. 67 sup. nectoph.; 85 inf. nectoph.
St. 139. 37°57′ N., 11°54′ E. 20. VII. 1910.
Y. 800 m w. 1 sup. nectoph.; 1 inf. nectoph.
St. 143. 35°18′ N., 16°25′ E. 23. VII. 1910.
Y. 1000 m w. 1 inf. nectoph.
St. 147. 31°35′ N., 19°02′ E. 25. VII. 1910.
Y. 300 m w. 2 inf. nectoph.
St. 152. 33°11′ N., 21°44′ E. 27. VII. 1910.
Y. 25 m w. 2 sup. nectoph.; 5 inf. nectoph.
St. 182. 38°13′ N., 24°48′ E. 14. VIII. 1910.
Y. 65 m w. 1 inf. nectoph.
St. 183. 37°52′ N., 23°09′ E. 16. VIII. 1910.
Y. 65 m w. 3 sup. nectoph.; 6 inf. nectoph.
St. 186. 37°57′ N., 19°51′ E. 17. VIII. 1910.
Y. 65 m w. 1 sup. nectoph.; 4 inf. nectoph.
Y. 300 m w. 2 sup. nectoph.; 2 inf. nectoph.
Y. 1200 m w. 2 sup. nectoph.; 1 inf. nectoph.
St. 189. 37°44′ N., 15°58′ E. 19. VIII. 1910.
Y. 300 m w. 2 sup. nectoph.; 2 inf. nectoph.
Y. 1000 m w. 5 sup. nectoph.; 2 inf. nectoph.
St. 190. 37°51′ N., 15°19′ E. 19. VIII. 1910.
Y. 25 m w. 13 sup. nectoph.; 10 inf. nectoph.
St. 192. 38°07′ N., 15°35′ E. 20. VIII. 1910.
Y. 25 m w. 1 sup. nectoph.; 1 inf. nectoph.
St. 193. 38°15′ N., 15°39′ E. 21. VIII. 1910.
Y. 10 m w. 6 sup. nectoph.; 8 inf. nectoph.
St. 194. 38°33′ N., 15°29′ E. 21. VIII. 1910.
Y. 25 m w. 11 nectoph.; 8 inf. nectoph.
St. 195. 39°02′ N., 14°55′ E. 21. VIII. 1910.
Y. 300 m w. 1 sup. nectoph.
St. 197. 40° 34′ N., 13° 36′ E. 24. VIII. 1910.
Y. 25 m w. 3 sup. nectoph.; 2 inf. nectoph.;
St. 199. 39° 32′ N., 10° 49′ E. 25 VIII. 1910.
Y. 25 m w. 7 sup. nectoph.; 16 inf. nectoph.
St. 200. 39°18′ N., 10°11′ E. 26 VIII. 1910.
Y. 25 m w. 5 inf. nectoph.

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[1] As already pointed out (Bigelow, 1931, p. 559) Moser's (1925, p. 148) statement that Bigelow had illustrated the basal wing of the inferior nectophore of *australis* as divided, was based on misreading of the legend. Actually the figure in question (Bigelow, 1911 b, Pl. 6, Fig. 2) was of the superior nectophore. The other figures (Pl. 5, Fig. 9, Pl. 6, Fig. 3) plainly show the undivided wing of the inferior bell.

St. 205. 39°16′ N., 5°52′ E. 27. VIII. 1910.
Y. 25 m w. 48 sup. nectoph.; 71 inf. nectoph.
St. 206. 39°32′ N., 5°15′ E. 28. VIII. 1910.
Y. 25 m w. 55 sup. nectoph.; 34 inf. nectoph.
Y. 300 m w. 6 sup. nectoph.; 2 inf. nectoph.
Y. 1000 m w. 3 sup. nectoph.; 1 inf. nectoph.
Y. 2000 m w. 7 sup. nectoph.; 11 inf. nectoph.
St. 217. 38°01′ N., 1°48′ E. 1. IX. 1910.
Y. 300 m w. 1 inf. nectoph.
St. 275. 39°05′ N., 14°50′ E. 3. IV. 1911.
S. 94 m w. 1 sup. nectoph.
St. 276. 36°30′ N., 19°20′ E. 4. IV. 1911.
S. 132 m w. 78 sup. nectoph.; 49 inf. nectoph.
St. 277. 33°20′ N., 27°30′ E. 6. IV. 1911.
S. 132 m w. 10 sup. nectoph.; 11 inf. nectoph.
St. 296. 32°10′ N., 29°50′ E. 25. VI. 1911.
S. 28 m w. 2 sup. nectoph.; 2 inf. nectoph.
St. 297. 33°10′ N., 25°03′ E. 25. VI. 1911.
S. 28 m w. 61 sup. nectoph.; 96 inf. nectoph.
St. 298. 34°20′ N., 21°10′ E. 26. VI. 1911.
S. 38 m w. 3 sup. nectoph.; 20 inf. nectoph.

This list includes all the superior nectophores of Galettinae which lack any trace of teeth, and in which the ventral wing is divided. In all of the better preserved examples a very small somatocyst is visible (Fig. 26 A, B, D, E), though all trace of this organ has been lost in many of the poorly preserved examples (the latter are in the majority). But as none of the better specimens have a long somatocyst, there is no reason to suppose that *chuni* is represented among the fragmentary specimens either, for it is likely that a somatocyst as large as that of *chuni* would be visible until disintegration had reached an advanced stage, as is the case in *Sulculeolaria*.

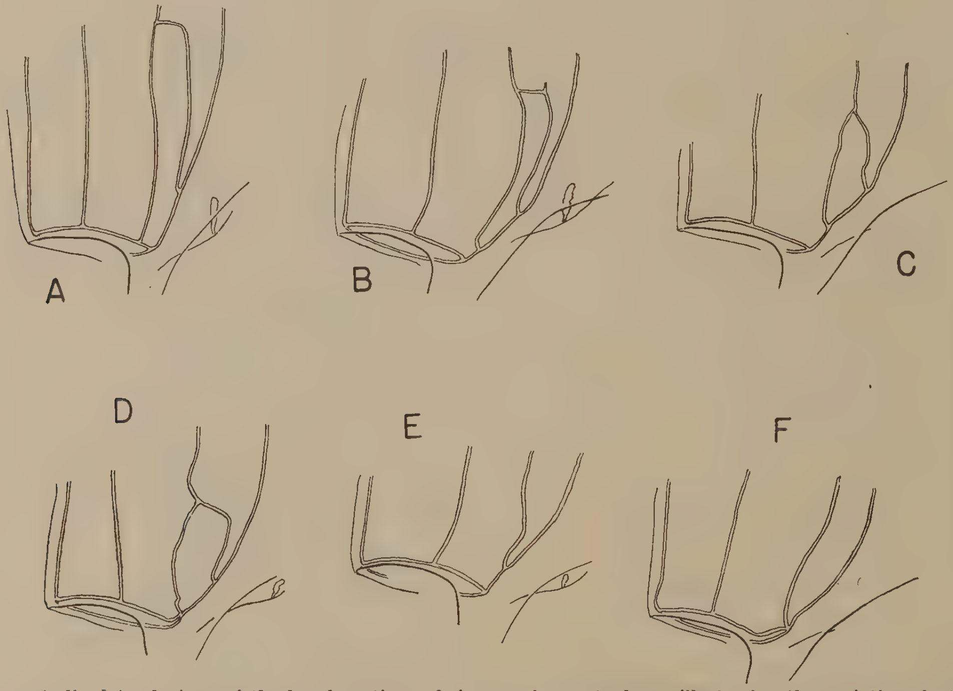

Fig. 26. *Galetta australis*; lateral views of the basal portions of six superior nectophores illustrating the variations in the lateral and commissural canals. A. Specimen with nectosac 14.5 mm. long from "Thor" St. 65; B—F Specimens with nectosacs 8—9 mm. long, from "Thor" St. 276. In specimens C and F, the somatocyst was too damaged for illustration.

All of the specimens also show the broad baso-ventral sector characteristic of *australis*. Since the canalization of the superior nectophore, i. e., whether with or without commissural trunks connecting the ascending lateral loop with the ventral, has been used as a specific character (see above, p. 34), it is worth record that very wide variation may occur in this respect, among specimens of roughly equal size and agreeing in the smallness of the somatocyst, as Candeias (1929) has already recorded. Seven specimens from one haul, at Station 276, for example, illustrate five distinguishable types (Fig. 26); three with and two without commissures. Furthermore, the ventral side of the lateral loop may arise either from the ring canal some little distance from the ventral, or jointly with the latter from the ring canal, or from the ventral canal some distance above the ring canal. And the commissural link, when present, may either depart from the lateral canal at an acute angle as is usual in *Sulculeolaria*, or at (roughly) a right angle. The point of junction also varies considerably in its height above the ring canal. Small subsidiary trunks have likewise been recorded, in one case forming a secondary union between the commissural and lateral canals (Candeias, 1929, p. 274, Fig. 4).

None of the specimens retain more than a basal fragment of the stem. For recent illustrations of the mode of association of the nectophores and of the stem groups see Bigelow, 1931, Figs. 204—207.

The inferior nectophores of the Galettinae listed above as *australis* include all those which lack teeth and have an undivided basal wing. The only species with which they might be confused are *chuni* and *turgida* (if the latter actually exists). But as these are not included among the superior nectophores, there is no reason to suppose they are among the inferiors, either.

### GALETTINAE genus?

The "Thor" also took the following specimens of Galettinae, so poorly preserved that it was impossible to identify them, even as to genus.

Material.

St. 76 47°01′ N., 5°48′ W. 10. III. 1909.
Y. 1600 m w. 4 nectoph.
St. 116. 39°27′ N., 5°26′ E. 29. VI. 1910.
Y. 25 m w. 1 inf. nectoph.
St. 132. 38°57′ N., 9°47′ E. 14. VII. 1910.
Y. 25 m w. 1 sup. nectoph.
St. 156. 32°16′ N., 26°03′ E. 30. VII. 1910.
Y. 1000 m w. 1 sup. nectoph.
St. 160. 35°59′ N., 28°14′ E. 1. VIII. 1910.
Y. 4000 m w. 1 sup. nectoph.
St. 178. 40°16′ N., 26°32′ E. 12. VIII. 1910.
Y. 65 m w. 1 inf. nectoph.

## DIPHYINAE Moser 1925.

The taxonomic arrangement within the Diphyinae has been in a state of flux during the past few years. This has been due in part to crystallization of opinion to the effect that the presence or absence of sterile swimming bells in the stem groups is not a proper generic character in this group (see discussions by Bigelow, 1931, p. 539; Moser, 1925, p. 131), and in part to the nomenclatural changes recently found necessary to accord with the accepted rules. Totton (1932) has also proposed that the old, broadly inclusive genus *Diphyes* be subdivided, to accord with the fact that its members fall into several categories of closely related species. In addition, there have been differences of opinion as to the proper location of the several species which (being monophyid) would fit in the older definition of the genus *Muggiaea* (see discussion, p. 38).

As recent authors agree with regard to the first of these matters, no further discussion is required here. And Totton's subdivision of the old genus *Diphyes* (including *Diphyopsis* auct.) seems a decided advance, as recognizing the fact that the species falling in each category, are more closely allied to one another, by a combination of characters, than they are to the members of the other categories. According to Totton's scheme, *Diphyes* (genotype, *D. dispar* Chamisso and Eysenhardt 1821) is limited to species in which the superior nectophore has large oral teeth, a deep hydroecium, and an undivided basal plate. The remaining Diphyinae he distributes among Huxley's (1859) old genus, *Eudoxoides* (genotype, *D. mitra* Huxley 1859), and two new genera, *Chelophyes* (genotype, *D. appendiculata* Eschscholtz 1829) and *Lensia* (genotype, *D. subtiloides* Lens and Van Riemsdijk 1908).

These new genera Totton defines as follows:—

*Chelophyes*:— "Baso-dorsal and lateral teeth absent from both nectophores. Posterior nectophore retained, its basal lamella with two strong teeth." (Totton, 1932, p. 354).

*Lensia*:— "Small diphyid Calycophorae, with pentagonal anterior and smaller fragile posterior nectophores. The anterior nectophore has a very shallow hydroecium, a short and divided mouth-plate and no dorsal or lateral teeth. Its radial canals have no commissures, and its somatocyst is short or of medium length." (Totton, 1932, p. 363).

The nectophores of *Eudoxoides*, according to TOTTON (1932, p. 346) are marked by "the peculiar lancet-shaped wings of the mouth-plate", and by "the shallow hydroecium with truncated apex".

By these definitions, *Lensia* and *Chelophyes* are confined to species with two bells, but the definitions for *Diphyes* and for *Eudoxoides* are broad enough to admit species with only a single bell. According to TOTTON, each of these last two genera does actually include at least one such monophyid form, *chamissonis* in the case of *Diphyes*, *spiralis* in the case of *Eudoxoides*. However, there is no place in his scheme, as it stands, for the two monophyid species that have been commonly known as *Muggiaea kochii* and *Muggiaea atlantica*. Quite apart from the number of bells, the absence of basal teeth and the fact that the basal wing is split would bar them from *Diphyes* as limited by him, the square or rounded corners of the basal wing from *Eudoxoides*, the deep hydroecium from *Lensia*, while the fact that there is a well developed dorsal ridge, running from base to apex of the superior nectophore, marks them off from the two species referred by TOTTON to *Chelophyes* in which the dorsal ridge terminates only a short distance above the base[1].

If the old genus *Muggiaea* be included among the Diphyinae, as now seems rational (p. 5), obviously some place must be found for its members in the generic subdivision of the sub-family. It is also highly desirable, from the practical standpoint of easy identification, that the primary generic characters be based as far as possible on homologous structures of the superior nectophore, for it is by these that Diphyinae are usually represented in collections. And it is obvious that when characters exhibited by the nectophore, can be correlated with characters of the bract, the presumption that we are dealing with a natural group is strengthened. It is equally obvious that whatever be one's viewpoint as to the phylogenetic relationship between monophyid and diphyid species, the use of the presence or absence of a second nectophore as a generic character, is extremely confusing, because this structure is so often lost, leaving no trace. Furthermore, there is no way of proving (and may never be!) whether some of them are ancestral and others regressive, or whether all of them are the latter. The decision in such a case will always be largely subjective.

With the foregoing considerations in mind, it now seems wise to cut the Gordian knot by discarding the number of nectophores altogether, as a generic character among Diphyinae. Fortunately, this course does not involve any serious disturbance of nomenclature, since the two old species of *Muggiaea*, *kochii* and *atlantica*, are more closely related one to the other, by structural characters, than is either of them to any other species.

The following generic definitions are therefore proposed, based primarily on the superior nectophore.

1. *Diphyes*, (genotype, *Diphyes dispar*, Chamisso and Eysenhardt 1821):—
   Superior nectophore pentagonal in cross section with long dorsal ridge; basal wing divided or not, its outer angles not produced; oral opening armed with teeth; an inferior nectophore occurs in some species, but not in others (*chamissonis*).
2. *Eudoxoides*, (genotype, *Diphyes mitra* Huxley 1859):—
   Superior nectophore pentagonal in cross section with long dorsal ridge; basal wing divided, its outer angles produced as lancet-shaped wings; oral margin without prominent teeth.
3. *Chelophyes*, (genotype, *Diphyes appendiculata* Eschscholtz 1829):—
   Superior nectophore quadrangular in cross section, dorsal ridge short, extending only a little distance upward from the base; basal wing divided, its outer angles not greatly produced; oral margin without prominent teeth. The two species so far known have two nectophores.
4. *Lensia*, (genotype, *Diphyes subtiloides* Lens and Van Riemsdijk 1908):—
   Superior nectophore pentagonal or polygonal in cross section, basal wing divided, its outer corners not produced; oral opening without large teeth; hydroecium very shallow, reaching hardly, if at all, above the oral level of the nectosac. So far as known all species have inferior nectophores.

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[1] Although this, with the resultant quadrangular form of the bell, is an outstanding feature of these two species, TOTTON does not include it in his generic characterization of *Chelophyes*.

5. *Muggiaea*, (genotype, *Muggiaea kochii* Will 1844):—
Superior nectophore pentagonal in cross section with long dorsal ridge; hydroecium deep; basal wing divided, its outer corners not produced; no oral teeth. The known species are monophyid.

The superior nectophores of the various Diphyinae are so sharply defined, by characters readily seen and subject to but little variation, that various keys of them can easily be arranged, for purposes of identification. One was offered in an earlier paper (Bigelow, 1911 b, p. 246). To take account of additional species since described, of the inclusion of the two species of *Muggiaea*, and of recent knowledge as to the relationship of other species, a new key is presented below, showing generic groupings, as well as specific distinctions.

| | | |
|---|---|---|
| 1. | Oral opening with prominent teeth (genus *Diphyes*) | 2 |
| | Oral opening without prominent teeth | 5 |
| 2. | Oral opening with a pair of lateral teeth only | *D. antarctica* |
| | Oral opening with one large dorsal, as well as a pair of lateral teeth | 3 |
| 3. | Left lateral ridge strongly twisted, apex only bluntly pointed | *D. chamissonis* |
| | Left lateral ridge not strongly twisted, apex narrowly acute | 4 |
| 4. | Dorsal side of basal wing bears a denticulate median crest; nectosac tubular at apex | *D. bojani* |
| | Basal wing without median crest; nectosac fusiform at apex | *D. dispar* |
| 5. | Mid-sector of bell quadrangular, with dorsal ridge extending only a short distance above base (genus *Chelophyes*) | 6 |
| | Mid-sector of bell pentagonal, or polygonal, with dorsal ridge extending nearly or quite to apex | 7 |
| 6. | Right lateral facet much narrower than left; somatocyst twisted to right | *C. contorta* |
| | Facets symmetrical except close to apex; somatocyst in mid-line | *C. appendiculata* |
| 7. | Outer angles of divided basal plate much produced, as lanceolate wings (genus *Eudoxoides*) | 8 |
| | Outer angles of divided basal plate square-cut, or rounded | 9 |
| 8. | Bell strongly twisted, spirally | *E. spiralis* |
| | Bell not spirally twisted | *E. mitra* |
| 9. | Hydroecial cavity extends well above oral level of nectosac (genus *Muggiaea*) | 10 |
| | Hydroecial cavity does not extend appreciably above oral level of nectosac, (genus *Lensia*) | 11 |
| 10. | Somatocyst extends nearly or quite to level of apex of nectosac, latero-basal outline of hydroecium nearly transverse to main axis of bell | *M. atlantica* |
| | Somatocyst extends little, if any, above mid-level of nectosac; latero-basal outline of hydroecium, strongly oblique to main axis of bell | *M. kochii* |
| 11. | See key to *Lensia*, p. 47. | |

# MUGGIAEA Busch 1851.

## **MUGGIAEA ATLANTICA** Cunningham 1892.

*Muggiaea atlantica*, Cunningham, 1892, p. 214.
For synonymy, see Bigelow, 1911 b, p. 187; Moser, 1925, p. 106.

### Material.

St. 46. 37°17′ N., 6°00′ E. 7. II. 1909.
Y. 65 m w. 11 nectoph.
St. 47. 36°55′ N., 3°12′ E. 10. II. 1909.
Y. 65 m w. 3 nectoph.
Y. 300 m w. 4 nectoph.

St. 50. 37°02′ N., 1°17′ E. 17. II. 1909.
Y. 25 m w. 17 nectoph.
Y. 65 m w. 1 nectoph.
Y. 300 m w. 1 nectoph.
Y. 600 m w. 2 nectoph.
Y. 1600 m w. 2 nectoph.

St. 51. 36°27′ N., 0°37′ W. 17. II. 1909.
Y. 300 m w. 2 nectoph.
St. 57. 36°40′ N., 3°30′ W. 20. II. 1909.
Y. 25 m w. 1 nectoph.
St. 59. 36°02′ N., 4°24′ W. 21. II. 1909.
Y. 25 m w. 10 nectoph.
Y. 100 m w. 11 nectoph.
Y. 1200 m w. 1 nectoph.
St. 63. 35°50′ N., 6°03′ W. 22. II. 1909.
Y. 600 m w. 3 nectoph.
St. 65. 35°53′ N., 7°26′ W. 24. II. 1909.
Y. 1600 m w. 1 nectoph.
St. 71. 39°35′ N., 9°45′ W. 4. III. 1909.
Y. 300 m w. 1 nectoph.
St. 84. 39°22′ N., 9°23′ W. 16. VI. 1910.
Y. 45 m w. 77 nectoph.
St. 85. 38°22′ N., 9°28′ W. 17. VI. 1910.
4 nectoph.
St. 93. 36°17′ N., 6°17′ W. 22. VI. 1910.
Y. 50 m w. 178 nectoph.
St. 94. 36°06′ N., 6°02′ W. 23. VI. 1910.
Y. 65 m w. 500? nectoph.
St. 95. 35°57′ N., 6°00′ W. 23. VI. 1910.
Y. 25 m w. 16 nectoph.
Y. 300 m w. 23 nectoph.
St. 96. 35°48′ N., 5°58′ W. 23. VI. 1910.
Y. 65 m w. 18 nectoph.
St. 98. 35°57′ N., 5°35′ W. 23. VI. 1910.
Y. 65 m w. 702 nectoph.
St. 99. 36°02′ N., 5°16′ W. 23. VI. 1910.
Y. 65 m w. 50 nectoph.
Y. 300 m w. 36 nectoph.
St. 106. 36°33′ N., 2°00′ W. 25. VI. 1910.
Y. 300 m w. 5 nectoph.
Y. 1200 m w. 1 nectoph.
St. 107. 36°18′ N., 1°14′ W. 25. VI. 1910.
Y. 65 m w. 93 nectoph.
Y. 300 m w. 21 nectoph.
Y. 2000 m w. 33 nectoph.
St. 108. 36°03′ N., 0°27′ W. 25. VI. 1910.
Y. 65 m w. 137 nectoph.
Y. 300 m w. 5 nectoph.
St. 112. 36°56′ N., 2°15′ E. 26. VI. 1910.
Y. 300 m w. 3 nectoph.
St. 113. 36°53′ N., 3°09′ E. 28. VI. 1910.
Y. 300 m w. 5 nectoph.
St. 122. 43°50′ N., 8°34′ E. 2. VII. 1910.
Y. 600 m w. 2 nectoph.
St. 147. 31°35′ N., 19°02′ E. 25. VII. 1910.
Y. 300 m w. 146 nectoph.
St. 152. 34°23′ N., 27°57′ E. 31. VII. 1910.
Y. 25 m w. 1 nectoph.
St. 221. 35°44′ N., 0°53′ W. 4. IX. 1910.
Y. 25 m w. 146 nectoph.
St. 225. 36°35′ N., 3°00′ W. 6. IX. 1910.
Y. 25 m w. 14 nectoph.

This species has been so fully described, first by Cunningham, more recently by Moser (1925, p. 106, Pl. 1, Fig. 5) and by Bigelow (1911 b, p. 187, Pl. 7, Fig. 1; Pl. 9, Figs. 7, 8), that we need merely summarize here, the diagnostic differences between it and *M. kochii*, the latter being the only species with which *atlantica* might be confused. The most striking difference is in the length of the somatocyst, which reaches, or surpasses the apex of the nectosac in *atlantica*, but hardly reaches to the mid-level of the nectosac in *kochii*. The relative depths of the hydroecium differ similarly, that of *atlantica* reaching about one quarter to one third the way up the nectosac in large specimens, but that of *kochii* only about one fifth the way. As noted above (p. 39), the latero-basal margin of the hydroecium is also much more strongly oblique to the main axis of the bell in *kochii* than in *atlantica*. On the other hand the two species agree, not only in the generic characters stated on p. 39, but in the narrowness of the somatocyst, and in its close apposition to the ventral wall of the nectosac, as well as in the conical outline of the hydroecial cavity as seen in side view. The maximum length so far recorded is 8 mm. for *atlantica*, 7 mm. for *kochii*[1].

## DIPHYES Cuvier 1817.

### **DIPHYES DISPAR** Chamisso and Eysenhardt 1821.

*Diphyes dispar*, Chamisso and Eysenhardt, 1821, p. 365, Pl. 33, Fig. 4.

For synonymy, see Bigelow, 1911 b, p. 257 (*Diphyopsis dispar*); Moser, 1925, p. 170; Leloup, 1933, p. 29.

Material.

St. 65. 35°53′ N., 7°26′ W. 24. II. 1909.
Y. 65 m w. 1 inf. nectoph.
St. 66. 36°16′ N., 6°52′ W. 25. II. 1909.
Y. 65 m w. 1 sup. nectoph.; 1 inf. nectoph.
St. 69. 36°13′ N., 9°44′ W. 28. II. 1909.
Y. 65 m w. 1 sup. nectoph.
Y. 300 m w. 2 sup. nectoph.; 3 inf. nectoph.
St. 205. 39°16′ N., 5°52′ E. 27. VIII. 1910.
Y. 25 m w. 1 sup. nectoph.; 1 inf. nectoph.

These few nectophores add nothing to the several excellent and detailed accounts of this species that have previously appeared; see especially Haeckel, 1888 b, p. 153, Pl. 33, 34, (*D. compressa*); and Moser, 1925, p. 170, Pl. 5—7, Pl. 8, Figs. 1, 2.

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[1] For excellent description of *kochii*, and an account of its chequered history, see Moser, 1925.

# CHELOPHYES Totton 1932.

## **CHELOPHYES APPENDICULATA** Eschscholtz 1829.

*Diphyes appendiculata*, Eschscholtz, 1829, p. 138, Pl. 12, Fig. 7.

For synonymy, see Bigelow, 1911 b, p. 248 (*Diphyes appendiculata*); Moser, 1925, p. 231 (*Diphyes sieboldii*); Leloup, 1933, p. 31.

### Material.

St. 10. 37°21′ N., 16°45′ E. 15. XII. 1908.
Y. 25 m w. 14 sup. nectoph.; 1 inf. nectoph.
Y. 65 m w. 2 sup. nectoph.
Y. 600 m w. 617 sup. nectoph.; 208 inf. nectoph.
St. 11. 36°57′ N., 18°16′ E. 16. XII. 1908.
Y. 25 m w. 101 sup. nectoph.; 4 inf. nectoph.
Y. 300 m w. 10 sup. nectoph.
Y. 1000 m w. 33 sup. nectoph.; 3 inf. nectoph.
St. 12. 39°34′ N., 17°17′ E. 19. XII. 1908.
Y. 300 m w. 27 sup. nectoph.; 1 inf. nectoph.
Y. 1000 m w. 253 sup. nectoph.; 59 inf. nectoph.
St. 13. 39°43′ N., 17°30′ E. 19. XII. 1908.
Y. 15 m w. 2 sup. nectoph.
Y. 1000 m w. 1511 sup. nectoph.; 548 inf. nectoph.
St. 14. 41°24′ N., 17°45′ E. 21. XII. 1908.
Y. 1000 m w. 53 sup. nectoph.; 1 inf. nectoph.
St. 15. 40°04′ N. 19°06′ E. 22. XII. 1908.
Y. 25 m w. 7 sup. nectoph.
Y. 1400 m w. 13 sup. nectoph.; 1 inf. nectoph.
St. 20. 37°48′ N., 15°49′ E. 5. I. 1909.
Y. 25 m w. 2 sup. nectoph.
St. 22. 38°50′ N., 15°18′ E. 7. I. 1909.
Y. 200 m w. 2 sup. nectoph.
St. 24. 40°14′ N., 12°23′ E. 16. I. 1909.
Y. 25 m w. 16 sup. nectoph.; 1 inf. nectoph.
Y. 65 m w. 26 sup. nectoph.; 1 inf. nectoph.
Y. 300 m w. 3 sup. nectoph.
Y. 600 m w. 280 sup. nectoph.; 57 inf. nectoph.
St. 26. 40°40′ N., 13°59′ E. 18. I. 1909.
Y. 300 m w. 2 sup. nectoph.
St. 27. 40°58′ N., 13°49′ E. 19. I. 1909.
Y. 25 m w. 2 sup. nectoph.
St. 29. 40°47′ N., 12°55′ E. 20. I. 1909.
Y. 200 m w. 21 sup. nectoph.; 2 inf. nectoph.
Y. 600 m w. 23 sup. nectoph.
Y. 1650 m w. 41 sup. nectoph.; 9 inf. nectoph.
St. 30. 41°15′ N., 11°55′ E. 21. I. 1909.
Y. 65 m w. 56 sup. nectoph.; 3 inf. nectoph.
Y. 300 m w. 30 sup. nectoph.; 5 inf. nectoph.
St. 31. 41°44′ N., 10°52′ E. 21. I. 1909.
Y. 65 m w. 77 sup. nectoph.; 14 inf. nectoph.
Y. 200 m w. 44 sup. nectoph.; 23 inf. nectoph.
Y. 600 m w. 81 sup. nectoph.; 50 inf. nectoph.
Y. 1400 m w. 78 sup. nectoph.; 15 inf. nectoph.
St. 33. 43°04′ N., 9°35′ E. 22. I. 1909.
Y. 65 m w. 12 sup. nectoph.; 2 inf. nectoph.
St. 34. 43°27′ N., 8°16′ E. 23. I. 1909.
Y. 25 m w. 61 sup. nectoph.; 44 inf. nectoph.
Y. 65 m w. 44 sup. nectoph.; 25 inf. nectoph.
Y. 200 m w. 120 sup. nectoph.; 89 inf. nectoph.
St. 35. 43°36′ N., 7°36′ E. 29. I. 1909.
Y. 200 m w. 3 sup. nectoph.
Y. 300 m w. 110 sup. nectoph.; 25 inf. nectoph.
S. 700 m w. 52 sup. nectophores; 43 inf. nectoph.
Y. 1000 m w. 379 sup. nectoph.; 265 inf. nectoph.
Y. 1600 m w. 108 sup. nectoph.; 62 inf. nectoph.
C. 2500 m w. 72 sup. nectoph.; 30 inf. nectoph.
St. 36. 42°49′ N., 6°54′ E. 30. I. 1909.
Y. 65 m w. 99 sup. nectoph.; 102 inf. nectoph.
Y. 300 m w. 262 sup. nectoph.; 137 inf. nectoph.
St. 38. 40°45′ N., 9°50′ E. 31. I. 1909.
Y. 25 m w. 29 sup. nectoph.; 4 inf. nectoph.
Y. 65 m w. 41 sup. nectoph.; 1 inf. nectoph.
Y. 150 m w. 42 sup. nectoph.; 5 inf. nectoph.
St. 39. 39°41′ N., 10°02′ E. 1. II. 1909.
Y. 25 m w. 116 sup. nectoph.; 25 inf. nectoph.
Y. 65 m w. 60 sup. nectoph.; 5 inf. nectoph.
Y. 300 m w. 36 sup. nectoph.; 9 inf. nectoph.
St. 40. 39°10′ N., 9°40′ E. 1. II. 1909.
Y. 65 m w. 54 sup. nectoph.; 2 inf. nectoph.
St. 42. 38°58′ N., 9°37′ E. 2. II. 1909.
Y. 300 m w. 24 sup. nectoph.; 6 inf. nectoph.
St. 43. 38°14′ N., 8°42′ E. 3. II. 1909.
Y. 65 m w. 123 sup. nectoph.; 20 inf. nectoph.
St. 46. 37°17′ N., 6°00′ E. 7. II. 1909.
Y. 65 m w. 11 sup. nectoph.
Y. 300 m w. 5 sup. nectoph.
Y. 600 m w. 24 sup. nectoph.; 2 inf. nectoph.
St. 47. 36°55′ N., 3°12′ E. 10. II. 1909.
Y. 65 m w. 89 sup. nectoph.; 9 inf. nectoph.
Y. 300 m w. 54 sup. nectoph.; 7 inf. nectoph.
St. 50. 37°02′ N., 1°17′ E. 17. II. 1909.
Y. 45 m w. 121 sup. nectoph.; 48 inf. nectoph.
Y. 65 m w. 27 sup. nectoph.; 2 inf. nectoph.
Y. 300 m w. 2 sup. nectoph.
Y. 600 m w. 4 sup. nectoph.; 1 inf. nectoph.
Y. 1600 m w. 1 col.; 1 sup. nectoph.
St. 51. 36°27′ N., 0°37′ W. 18. II. 1909.
Y. 300 m w. 4 sup. nectoph.
St. 52. 35°55′ N., 1°02′ W. 18. II. 1909.
Y. 300 m w. 1 col.; 4 sup. nectoph.
St. 53. 36°13′ N., 1°28′ W. 18. II. 1909.
C. 2600 m w. 4 sup. nectoph.
St. 55. 36°46′ N., 2°18′ W. 19. II. 1909.
Y. 25 m w. 18 sup. nectoph.; 9 inf. nectoph.
Y. 65 m w. 12 sup. nectoph.; 3 inf. nectoph.
St. 57. 36°40′ N., 3°30′ W. 20. II. 1909.
Y. 25 m w. 4 sup. nectoph.
Y. 200 m w. 4 sup. nectoph.
St. 58. 36°36′ N., 4°24′ W. 20. II. 1909.
Y. 65 m w. 2 sup. nectoph.
Y. 100 m w. 6 sup. nectoph.; 4 inf. nectoph.
St. 59. 36°02′ N., 4°24′ W. 21. II. 1909.
Y. 25 m w. 65 sup. nectoph.; 2 inf. nectoph.
Y. 100 m w. 5 sup. nectoph.; 1 inf. nectoph.
Y. 500 m w. 2 sup. nectoph.
Y. 1200 m w. 5 sup. nectoph.
St. 61. 35°57′ N., 5°35′ W. 21. II. 1909.
Y. 600 m w. 3 sup. nectoph.
St. 62. 35°45′ N., 5°59′ W. 21. II. 1909.
Y. 25 m w. 80 sup. nectoph.; 20 inf. nectoph.
St. 63. 35°50′ N., 6°03′ W. 22. II. 1909.
Y. 25 m w. 63 sup. nectoph.; 9 inf. nectoph.
Y. 600 m w. 57 sup. nectoph.; 11 inf. nectoph.
St. 65. 35°53′ N., 7°26′ W. 24. II. 1909.
Y. 25 m w. 14 sup. nectoph.
Y. 65 m w. 388 sup. nectoph.; 18 inf. nectoph.
Y. 300 m w. 328 sup. nectoph.; 48 inf. nectoph.
Y. 600 m w. 170 sup. nectoph.; 26 inf. nectoph.
Y. 1600 m w. 33 sup. nectoph.; 3 inf. nectoph.
St. 66. 36°16′ N., 6°52′ W. 25. II. 1909.
Y. 25 m w. 1 sup. nectoph.
Y. 65 m w. 90 sup. nectoph.; 23 inf. nectoph.
Y. 300 m w. 175 sup. nectoph.; 50 inf. nectoph.
Y. 600 m w. 17 sup. nectoph.; 4 inf. nectoph.
Y. 1200 m w. 25 sup. nectoph.; 2 inf. nectoph.
St. 68. 36°39′ N., 7° 21′ W. 27. II. 1909.
Y. 800 m w. 41 sup. nectoph.; 18 inf. nectoph.

St. 69. 36°13′ N., 9°44′ W. 28. II. 1909.
Y. 25 m w. 55 sup. nectoph.; 37 inf. nectoph.
Y. 65 m w. 4 col.; 122 sup. nectoph.; 188 inf. nectoph.
Y. 300 m w. 218 sup. nectoph.; 132 inf. nectoph.
Y. 600 m w. 1 col.; 72 sup. nectoph.; 66 inf. nectoph.
C. 3000 m w. 41 sup. nectoph.; 20 inf. nectoph.
St. 70. 39°06′ N., 9°47′ W. 4. III. 1909.
Y. 65 m w. 61 sup. nectoph.; 29 inf. nectoph.
St. 71. 39°35′ N., 9°45′ W. 4. III. 1909.
Y. 300 m w. 96 sup. nectoph.; 66 inf. nectoph.
Y. 600 m w. 8 sup. nectoph.; 4 inf. nectoph.
Y. 1600 m w. 1 inf. nectoph.
St. 74. 44°21′ N., 7°55′ W. 8. III. 1909.
Y. 300 m w. 12 sup. nectoph.; 8 inf. nectoph.
St. 75. 45°37′ N., 7°03′ W. 9. III. 1909.
Y. 300 m w. 2 sup. nectoph.; 2 inf. nectoph.
Y. 600 m w. 2 sup. nectoph.
C. 4300 m w. 4 sup. nectoph.; 1 inf. nectoph.
St. 76. 47°01′ N., 5°48′ W. 10. III. 1909.
Y. 600 m w. 1 sup. nectoph.
Y. 1600 m w. 1 sup. nectoph.
St. 80. 46°17′ N., 7°31′ W. 13. VI. 1910.
Y. 25 m w. 1 sup. nectoph.
St. 81. 41°32′ N., 9°32′ W. 15. VI. 1910.
Y. 300 m w. 2 sup. nectoph.
Y. 500 m w. 3 sup. nectoph.; 3 inf. nectoph.
St. 85. 38°22′ N., 9°28′ W. 17. VI. 1910.
Y. 65 m w. 2 sup. nectoph.
St. 86. 37°22′ N., 9°15′ W. 17. VI. 1910.
P. Surface. 36 sup. nectoph.; 18 inf. nectoph.
St. 87. 37°03′ N., 9°15′ W. 17. VI. 1910.
Y. 65 m w. 18 sup. nectoph.; 13 inf. nectoph.
Y. 300 m w. 187 sup. nectoph.; 135 inf. nectoph.
St. 89. 36°28′ N., 8°22′ W. 18. VI. 1910.
Y. 65 m w. 33 col.; 1185 sup. nectoph.; 678 inf. nectoph.
Y. 300 m w. 156 sup. nectoph.; 50 inf. nectoph.
Y. 1000 m w. 345 sup. nectoph.; 109 inf. nectoph.
St. 91. 35°53′ N., 7°26′ W. 18. VI. 1910.
Y. 300 m w. 2 col.; 980 sup. nectoph.; 657 inf. nectoph.
Y. 1600 m w. 153 sup. nectoph.; 79 inf. nectoph.
St. 92. 36°16′ N., 6°50′ W. 19. VI. 1910.
Y. 65 m w. 5585 ± sup. nectoph.; 4945 ± inf. nectoph.[1].
St. 94. 36°06′ N., 6°02′ W. 23. VI. 1910.
Y. 65 m w. 1 col.; 4 sup. nectoph.; 4 inf. nectoph.
St. 95. 35°57′ N., 6°00′ W. 23. VI. 1910.
Y. 25 m w. 59 sup. nectoph.; 51 inf. nectoph.
Y. 65 m w. 2 col.; 37 sup. nectoph.; 19 inf. nectoph.
Y. 300 m w. 8 sup. nectoph.; 8 inf. nectoph.
St. 96. 35°48′ N., 5°58′ W. 23. VI. 1910.
Y. 65 m w. 1 col.; 30 sup. nectoph.; 28 inf. nectoph.
St. 98. 35°57′ N., 5°35′ W. 23. VI. 1910.
Y. 65 m w. 34 sup. nectoph.; 30 inf. nectoph.
St. 99. 36°02′ N., 5°16′ W. 23. VI. 1910.
Y. 65 m w. 5 sup. nectoph.; 1 inf. nectoph.
Y. 300 m w. 205 sup. nectoph.; 130 inf. nectoph.
St. 104. 36°37′ N., 2°04′ W. 24. VI. 1910.
Y. 65 m w. 3 col.; 23 sup. nectoph.; 5 inf. nectoph.
St. 105. 36°43′ N., 2°08′ W. 24. VI. 1910.
Y. 40 m w. 2 sup. nectoph.
St. 106. 36°33′ N., 2°00′ W. 25. VI. 1910.
Y. 300 m w. 3 sup. nectoph.; 4 inf. nectoph.
Y. 1200 m w. 2 col.; 14 sup. nectoph.; 3 inf. nectoph.
St. 107. 36°18′ N., 1°14′ W. 25. VI. 1910.
Y. 65 m w. 1 col.; 29 sup. nectoph.; 18 inf. nectoph.
Y. 300 m w. 21 sup. nectoph.; 6 inf. nectoph.
Y. 2000 m w. 1 col.; 4 sup. nectoph.; 2 inf. nectoph.
St. 108. 36°03′ N., 0°27′ W. 25. VI. 1910.
Y. 25 m w. 7 sup. nectoph.; 7 inf. nectoph.
Y. 65 m w. 1 sup. nectoph.
Y. 300 m w. 3 sup. nectoph.; 2 inf. nectoph.
St. 112. 36°56′ N., 2°15′ E. 27. VI. 1910.
Y. 25 m w. 8 col.; 699 sup. nectoph.; 110 inf. nectoph.
Y. 65 m. w. 82 sup. nectoph.; 16 inf. nectoph.
Y. 300 m w. 2 col.; 21 sup. nectoph.; 1 inf. nectoph.
St. 113. 36°53′ N., 3°09′ E. 28. VI. 1910.
Y. 300 m w. 3 col.; 16 sup. nectoph.; 7 inf. nectoph.
St. 115. 38°17′ N., 4°11′ E. 28. VI. 1910.
Y. 25 m w. 24 col.; 491 sup. nectoph.; 277 inf. nectoph.
Y. 65 m w. 31 col.; 378 sup. nectoph.; 292 inf. nectoph.
Y. 300 m w. 36 sup. nectoph.; 11 inf. nectoph.
Y. 2000 m w. 61 sup. nectoph.; 43 inf. nectoph.
St. 116. 39°27′ N., 5°26′ E. 29. VI. 1910.
Y. 25 m w. 24 col.; 577 sup. nectoph.; 225 inf. nectoph.
Y. 65 m w. 2 col.; 97 sup. nectoph.; 53 inf. nectoph.
Y. 300 m w. 2 col.; 109 sup. nectoph.; 55 inf. nectoph.
St. 118. 41°00′ N., 6°43′ E. 30. VI. 1910.
Y. 25 m w. 265 sup. nectoph.; 168 inf. nectoph.
Y. 65 m w. 3 col.; 86 sup. nectoph.; 40 inf. nectoph.
Y. 300 m w. 136 sup. nectoph.; 76 inf. nectoph.
St. 120. 42°31′ N., 7°41′ E. 1. VII. 1910.
Y. 300 m w. 86 sup. nectoph.; 60 inf. nectoph.
St. 121. 43°08′ N., 8°05′ E. 2. VII. 1910.
Y. 25 m w. 3 col.; 215 sup. nectoph.; 35 inf. nectoph.
St. 122. 43°50′ N., 8°34′ E. 2. VII. 1910.
Y. 600 m w. 201 sup. nectoph.; 145 inf. nectoph.
Y. 1200 m w. 34 sup. nectoph.; 21 inf. nectoph.
St. 123. 44°14′ N., 8°55′ E. 3. VII. 1910.
Y. 10 m w. 646 sup. nectoph.; 9 inf. nectoph.
Y. 25 m w. 6 col.; 1064 sup. nectoph.; 100 inf. nectoph.
Y. 65 m w. 21 col.; 3324 sup. nectoph.; 721 inf. nectoph.
Y. 300 m w. 242 sup. nectoph.; 93 inf. nectoph.
St. 124. 44°20′ N., 9°05′ E. 3. VII. 1910.
Y. 65 m w. 415 sup. nectoph.; 51 inf. nectoph.
St. 125. 43°54′ N., 9°13′ E. 9. VII. 1910.
Y. 25 m w. 309 sup. nectoph.; 106 inf. nectoph.
Y. 300 m w. 32 sup. nectoph.; 21 inf. nectoph.
St. 126. 42°43′ N., 9°50′ E. 10. VII. 1910.
Y. 25 m w. 418 sup. nectoph.; 49 inf. nectoph.
Y. 300 m w. 2 col.; 116 sup. nectoph.; 31 inf. nectoph.
St. 129. 40°05′ N., 11°31′ E. 12. VII. 1910.
Y. 25 m w. 1280 sup. nectoph.; 75 inf. nectoph.
Y. 300 m w. 82 sup. nectoph.; 23 inf. nectoph.
Y. 600 m w. 77 sup. nectoph.; 35 inf. nectoph.
Y. 1000 m w. 2 col.; 66 sup. nectoph.; 23 inf. nectoph.
C. 3500 m w. 48 sup. nectoph.; 25 inf. nectoph.
St. 130. 39°35′ N., 11°20′ E. 13. VII. 1910.
Y. 25 m w. 6 col.; 944 sup. nectoph.; 731 inf. nectoph.
St. 131. 38°36′ N., 11°00′ E. 13. VII. 1910.
Y. 25 m w. 4 col.; 84 sup. nectoph.; 8 inf. nectoph.
Y. 300 m w. 17 sup. nectoph.; 2 inf. nectoph.
Y. 1000 m w. 25 sup. nectoph.; 7 inf. nectoph.
St. 132. 38°57′ N., 9°47′ E. 14. VI. 1910.
Y. 25 m w. 273 sup. nectoph.; 188 inf. nectoph.
Y. 300 m w. 17 col.; 357 sup. nectoph.; 253 inf. nectoph.
Y. 600 m w. 6 col.; 638 sup. nectoph.; 530 inf. nectoph.
St. 133. 38°18′ N., 9°59′ E. 14. VII. 1910.
Y. 25 m w. 342 sup. nectoph.; 183 inf. nectoph.
Y. 300 m w. 36 sup. nectoph.; 12 inf. nectoph.
Y. 600 m w. 37 sup. nectoph.; 17 inf. nectoph.
St. 134. 37°37′ N., 10°17′ E. 15. VII. 1910.
Y. 25 m w. 117 sup. nectoph.; 38 inf. nectoph.
Y. 300 m w. 12 col.; 75 sup. nectoph.; 79 inf. nectoph.
St. 135. 37°17′ N., 10°28′ E. 15. VII. 1910.
Y. 25 m w. 4 sup. nectoph.; 2 inf. nectoph.
St. 136. 37°01′ N., 10°31′ E. 19. VII. 1910.
Y. 25 m w. 24 sup. nectoph.; 13 inf. nectoph.
Y. 100 m w. 3 sup. nectoph.; 1 inf. nectoph.
St. 137. 37°17′ N., 10°56′ E. 19. VII. 1910.
Y. 25 m w. 12 col.; 268 sup. nectoph.; 115 inf. nectoph.
Y. 250 m w. 91 sup. nectoph.; 59 inf. nectoph.
St. 138. 37°37′ N., 11°25′ E. 19. VII. 1910.
Y. 25 m w. 2 col.; 520 sup. nectoph.; 277 inf. nectoph.
Y. 300 m w. 2 col.; 42 sup. nectoph.; 21 inf. nectoph.
Y. 1000 m w. 86 sup. nectoph.; 36 inf. nectoph.
St. 139. 37°57′ N., 11°54′ E. 20. VII. 1910.
Y. 25 m w. 5 sup. nectoph.; 7 inf. nectoph.
Y. 300 m w. 4 sup. nectoph.; 2 inf. nectoph.
Y. 800 m w. 1 inf. nectoph.
St. 141. 36°42′ N., 13°34′ E. 20. VII. 1910.
Y. 25 m w. 3 col.; 198 sup. nectoph.; 98 inf. nectoph.

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[1] See note [1] on p. 44.

St. 142. 35°44′ N., 15°07′ E. 22. VII. 1910.
Y. 25 m w. 2 col.; 679 sup. nectoph.; 56 inf. nectoph.
Y. 150 m w. 43 sup. nectoph.; 1 inf. nectoph.
St. 143. 35°18′ N., 16°25′ E. 22. VII. 1910.
Y. 25 m w. 1 col.; 110 sup. nectoph.; 45 inf. nectoph.
Y. 300 m w. 1 col.; 79 sup. nectoph.; 18 inf. nectoph.
Y. 1000 m w. 1 col.; 57 sup. nectoph.; 12 inf. nectoph.
St. 144. 34°31′ N., 18°40′ E. 23. VII. 1910.
Y. 25 m w. 1 col.; 82 sup. nectoph.; 69 inf. nectoph.
Y. 300 m w. 10 sup. nectoph.; 5 inf. nectoph.
Y. 2000 m w. 5 sup. nectoph.; 2 inf. nectophores.
C. 4000 m w. 3 sup. nectoph.; 2 inf. nectoph.
St. 145. 32°38′ N., 19°02′ E. 25. VII. 1910.
Y. 25 m w. 110 sup. nectoph.; 28 inf. nectoph.
Y. 300 m w. 1 col.; 22 sup. nectoph.; 9 inf. nectoph.
St. 147. 31°35′ N., 19°02′ E. 25. VII. 1910.
Y. 25 m w. 21 sup. nectoph.; 2 inf. nectoph.
Y. 300 m w. 11 sup. nectoph.
Y. 1000 m w. 6 sup. nectoph.
St. 152. 33°11′ N., 21° 44′ E. 27. VII. 1910.
Y. 25 m w. 39 sup. nectoph.; 34 inf. nectoph.
Y. 300 m w. 15 sup. nectoph.; 8 inf. nectoph.
Y. 1000 m w. 8 sup. nectoph.; 2 inf. nectoph.
St. 154. 32°10′ N., 24°46′ E. 29. VII. 1910.
Y. 300 m w. 1 sup. nectoph.; 1 inf. nectoph.
St. 156. 32°16′ N., 26°03′ E. 29. VII. 1910.
Y. 25 m w. 2 col.; 211 sup. nectoph.; 94 inf. nectoph.
Y. 600 m w. 4 sup. nectoph.; 2 inf. nectoph.
Y. 1000 m w. 13 sup. nectoph.; 6 inf. nectoph.
St. 158. 34°23′ N., 27°57′ E. 31. VII. 1910.
Y. 300 m w. 1 col.; 12 sup. nectoph.; 3 inf. nectoph.
St. 160. 35°59′ N., 28°14′ E. 1. VIII. 1910.
Y. 25 m w. 3 col.; 569 sup. nectoph.; 69 inf. nectoph.
Y. 300 m w. 8 sup. nectoph.; 3 inf. nectoph.
Y. 1000 m w. 2 col.; 23 sup. nectoph.; 8 inf. nectoph.
Y. 4000 m w. 6 sup. nectoph.; 1 inf. necotph.
St. 161. 36°12′ N., 27°16′ E. 2. VIII. 1910.
Y. 25 m w. 13 sup. nectoph.; 5 inf. nectoph.
St. 163. 37°52′ N., 26°22′ E. 2. VIII. 1910.
Y. 25 m w. 8 sup. nectoph.
St. 179. 40°02′ N., 25°55′ E. 13. VIII. 1910.
Y. 65 m w. 2 sup. nectoph.
St. 181. 38°49′ N., 25°09′ E. 13. VIII. 1910.
Y. 65 m w. 10 sup. nectoph.
Y. 300 m w. 1 col.; 15 sup. nectoph.; 2 inf. nectoph.
St. 182. 38°18′ N., 24°48′ E. 14. VIII. 1910.
Y. 10 m w. 3 col.; 73 sup. nectoph.; 2 inf. nectoph.
Y. 65 m w. 5 col.; 78 sup. nectoph.; 4 inf. nectoph.
Y. 600 m w. 2 col.; 48 sup. nectoph.; 4 inf. nectoph.
St. 183. 37°52′ N., 23°09′ E. 16. VIII. 1910.
Y. 65 m w. 4 col.; 912 sup. nectoph.; 219 inf. nectoph.
Y. 300 m w. 9 col.; 373 sup. nectoph.; 76 inf. nectoph.
St. 185. 38°12′ N., 21°17′ E. 17. VIII. 1910.
Y. 25 m w. 43 sup. nectoph.; 6 inf. nectoph.
St. 186. 37°57′ N., 19°51′ E. 17. VIII. 1910.
Y. 10 m w. 32 sup. nectoph.; 18 inf. nectoph.
Y. 65 m w. 323 sup. nectoph.; 123 inf. nectoph.
Y. 300 m w. 2 col.; 163 sup. nectoph.; 85 inf. nectoph.
Y. 1200 m w. 213 sup. nectoph.; 95 inf. nectoph.
St. 187. 37°54′ N., 18°02′ E. 18. VIII. 1910.
Y. 25 m w. 5 sup. nectoph.
Y. 300 m w. 18 sup. nectoph.
Y. 1000 m w. 29 sup. nectoph.; 12 inf. nectoph.
St. 189. 37°44′ N., 15°58′ E. 19. VIII. 1910.
Y. 25 m w. 16 sup. nectoph.; 1 inf. nectoph.
Y. 300 m w. 2 col.; 78 sup. nectoph.; 9 inf. nectoph.
Y. 1000 m w. 1 col.; 85 sup. nectoph.; 30 inf. nectoph.
St. 190. 37°51′ N., 15°19′ E. 19. VIII. 1910.
Y. 25 m w. 243 sup. nectoph.; 66 inf. nectophores.
St. 192. 38°07′ N., 15°35′ E. 20. VIII. 1910.
Y. 25 m w. 11 col.; 1779 sup. nectoph.; 144 inf. nectoph.
Y. 300 m w. 3 col.; 36 sup. nectoph.; 5 inf. nectoph.
Y. 600 m w. 1 col.; 82 sup. nectoph.; 16 inf. nectoph.
St. 193. 38°15′ N., 15°39′ E. 21. VIII. 1910.
Y. 19 m w. 2 col.; 870 sup. nectoph.; 163 inf. nectoph.
St. 194. 38°33′ N., 15°29′ E. 21. VIII. 1910.
Y. 10 m w. 2 col.; 370 sup. nectoph.; 2 inf. nectoph.
Y. 25 m w. 4 col.; 1095 sup. nectoph.; 51 inf. nectoph.
Y. 1200 m w. 3 col.; 80 sup. nectoph.; 29 inf. nectoph.
St. 195. 39°02′ N., 14°55′ E. 21. VIII. 1910.
Y. 25 m w. 3 col.; 81 sup. nectoph.; 3 inf. nectoph.
Y. 300 m w. 124 sup. nectoph.; 80 inf. nectoph.
St. 196. 39°59′ N., 14°31′ E. 22. VIII. 1910.
Y. 25 m w. 4 col.; 338 sup. nectoph.; 103 inf. nectoph.
St. 197. 40°34′ N., 13°36′ E. 24. VIII. 1910.
Y. 25 m w. 19 sup. nectoph.; 5 inf. nectoph.
Y. 300 m w. 2 col.; 53 sup. nectoph.; 18 inf. nectoph.
St. 199. 39°32′ N., 10°49′ E. 25. VIII. 1910.
Y. 25 m w. 1 col.; 32 sup. nectoph.; 4 inf. nectoph.
Y. 300 m w. 239 sup. nectoph.; 171 inf. nectoph.
Y. 1000 m w. 2 col.; 86 sup. nectoph.; 39 inf. nectoph.
St. 200. 39°18′ N., 10°11′ E. 26. VIII. 1910.
Y. 25 m w. 7 col.; 1043 sup. nectoph.; 36 inf. nectoph.
St. 202. 38°59′ N., 9°25′ E. 26. VIII. 1910.
Y. 300 m w. 1 col.; 80 sup. nectoph.; 41 inf. nectoph.
St. 204. 38°52′ N., 7°43′ E. 27. VIII. 1910.
Y. 25 m w. 10 col.; 436 sup. nectoph.; 19 inf. nectoph.
Y. 65 m w. 4 col.; 758 sup. nectoph.; 371 inf. nectoph.
Y. 300 m w. 1 col.; 63 sup. nectoph.; 30 inf. nectoph.
Y. 1000 m w. 1 col.; 68 sup. nectoph.; 25 inf. nectoph.
St. 205. 39°16′ N., 5°52′ E. 27. VIII. 1910.
Y. 25 m w. 205 sup. nectoph.; 11 inf. nectoph.
St. 206. 39°32′ N., 5°15′ E. 28. VIII. 1910.
Y. 25 m w. 113 sup. nectoph.; 40 inf. nectoph.
Y. 300 m w. 3 col.; 47 sup. nectophores; 36 inf. nectoph.
Y. 1000 m w. 5 col.; 113 sup. nectoph.; 51 inf. nectoph.
Y. 2000 m w. 138 sup. nectophores; 64 inf. nectoph.
St. 207. 39°58′ N., 3°41′ E. 28. VIII. 1910.
Y. 25 m w. 4 col.; 992 sup. nectoph.; 62 inf. nectoph.
Y. 65 m w. 2 col.; 30 sup. nectoph.; 3 inf. nectoph.
Y. 100 m w. 2 col.; 81 sup. nectoph.; 46 inf. nectoph.
St. 208. 40°18′ N., 3°20′ E. 29. VIII. 1910.
Y. 25 m w. 8 col.; 620 sup. nectoph.; 357 inf. nectoph.
St. 209. 40°34′ N., 3°03′ E. 29. VIII. 1910.
N. 0—35 m. 14 sup. nectoph.; 4 inf. nectoph.
N. 35—75 m. 7 sup. nectoph.
C. 150 m w. 1 col.; 338 sup. nectoph.; 76 inf. nectoph.
Y. 25 m w. 88 sup. nectoph.; 6 inf. nectoph.
Y. 100 m w. 2 col.; 326 sup. nectoph.; 43 inf. nectoph.
Y. 300 m w. 6 col.; 233 sup. nectoph.; 141 inf. nectoph.
Y. 2000 m w. 1 col.; 102 sup. nectoph.; 36 inf. nectoph.
St. 210. 41°10′ N., 2°23′ E. 30. VIII. 1910.
Y. 25 m w. 1 col.; 99 sup. nectoph.; 9 inf. nectoph.
Y. 600 m w. 69 sup. nectoph.; 22 inf. nectoph.
St. 213. 40°14′ N., 0°54′ E. 31. VIII. 1910.
Y. 25 m w. 5 sup. nectoph.
Y. 95 m w. 65 sup. necrophores; 33 inf. nectoph.
St. 215. 39°14′ N., 0°52′ E. 31. VIII. 1910.
Y. 25 m w. 300 sup. nectoph.; 135 inf. nectoph.
St. 216. 38°31′ N., 1°24′ E. 1. IX. 1910.
Y. 25 m w. 1 col.; 272 sup. nectoph.; 29 inf. nectoph.
St. 217. 38°01′ N., 1°48′ E. 1. IX. 1910.
Y. 300 m w. 17 sup. nectoph.; 12 inf. nectoph.
St. 218. 36°54′ N., 2°57′ E. 2. IX. 1910.
Y. 25 m w. 65 sup. nectoph.; 37 inf. nectoph.
St. 220. 36°25′ N., 0°42′ E. 4. IX. 1910.
Y. 25 m w. 7 col.; 231 sup. nectoph.; 202 inf. nectoph.
St. 221. 35°44′ N., 0°53′ W. 4. IX. 1910.
Y. 25 m w. 3 sup. nectoph.; 1 inf. nectoph.
St. 222. 35°53′ N., 0°57′ W. 4. IX. 1910.
Y. 300 m w. 1 sup. nectoph.; 1 inf. nectoph.
St. 223. 36°13′ N., 1°28′ W. 5. IX. 1910.
Y. 25 m w. 2 col.; 224 sup. nectoph.; 143 inf. nectoph.
Y. 300 m w. 5 sup. nectoph.; 3 inf. nectoph.
St. 225. 36°35′ N., 3°00′ W. 6. IX. 1910.
Y. 25 m w. 5 sup. nectoph.; 2 inf. nectoph.
St. 229. 35°51′ N., 5°58′ W. 8. IX. 1910.
Y. 45 m w. 9 sup. nectoph.; 1 inf. nectoph.
Y. 300 m w. 3 sup. nectoph.; 2 inf. nectoph.

St. 231. 35°56′ N., 7°16′ W. 9. IX. 1910.
Y. 25 m w. 91 sup. nectoph.; 28 inf. nectoph.
St. 232. 36°29′ N., 9°06′ W. 9. IX. 1910.
Y. 25 m w. 393 sup. nectoph.; 24 inf. nectoph.
Y. 300 m w. 4 col.; 173 sup. nectoph.; 6 inf. nectoph.
Y. 1000 m w. 131 sup. nectoph.; 5 inf. nectoph.
St. 233. 36°49′ N., 9°15′ W. 10. IX. 1910.
Y. 25 m w. 353 sup. nectoph.; 171 inf. nectoph.[1].
St. 234. 38°10′ N., 9°20′ W. 10. IX. 1910.
Y. 25 m w. 1 col.; 147 sup. nectoph.; 67 inf. nectoph.
Y. 1000 m w. 37 sup. nectoph.; 20 inf. nectoph.
St. 275. 39°05′ N., 14°50′. E. 3. IV. 1911.
S. 94 m w. 10 sup. nectoph.; 6 inf. nectoph.
St. 276. 36°30′ N., 19°20′ E. 4. IV. 1911.
S. 132 m w. 157 sup. nectoph.; 16 inf. nectoph.
St. 277. 33°20′ N., 27°30′ E. 6. IV. 1911.
S. 132 m w. 185 sup. nectoph.; 8 inf. nectoph.
St. 278. 38°11.5′ N., 15°37.5′ E. 22. II. 1911.
S. 15 m w. 123 sup. nectoph.; 25 inf. nectoph.
St. 279. 38°11.5′ N., 15°36.5′ E. 23. II. 1911.
S. 30 m w. 92 sup. nectoph.; 30 inf. nectoph.
St. 280. 38°11′ N., 15°36.5′ E. 25. II. 1911.
S. 15 m w. 79 sup. nectoph.; 21 inf. nectoph.
St. 281. 38°15′ N., 15°37.5′ E. 1. III. 1911.
S. 10 m w. 19 sup. nectoph.; 3 inf. nectoph.
S. 30 m w. 39 sup. nectoph.; 15 inf. nectoph.
S. 40 m w. 69 sup. nectoph.; 14 inf. nectoph.
St. 282. 38°12′ N., 15°37′ E. 8. III. 1911.
S. 40 m w. 222 sup. nectoph.; 48 inf. nectoph.
St. 283. 38°12′ N., 15°37′ E. 12. III. 1911.
S. 40 m w. 90 sup. nectoph.; 34 inf. nectoph.
St. 296. 32°10′ N., 29°50′ E. 25. VI. 1911.
S. 28 m w. 9 sup. nectoph.; 5 inf. nectoph.
St. 297. 33°10′ N., 25°03′ E. 25. VI. 1911.
S. 28 m w. 7 sup. nectoph.; 2 inf. nectoph.
St. 298. 34°20′ N., 21°10′ E. 26. VI. 1911.
S. 38 m w. 4 sup. nectoph.; 1 inf. nectoph.
St. 339. 40°30′ N., 3°10′ E. 20. VIII. 1911.
S. 28 m w. 25 sup.. nectoph.
St. 340. 35°50′ N., 21°30′ E. 26. VIII. 1911.
S. 28 m w. 1 sup. nectoph.
St. 341. 34°00′ N., 26°20′ E. 27. VIII. 1911.
S. 28 m w. 3 col.; 106 sup. nectoph.
S. 108 m w. 8 sup. nectoph.

Most recent authors agree in the choice of Eschscholtz's (1829) old name *appendiculata* for this well known species. Moser (1911, 1913a, 1925) on the contrary, considers Eschscholtz's (1829) account of his *appendiculata* unrecognizable, hence discards that name in favor of *sieboldii* Kölliker, the identity of which is certain. Reasons are given elsewhere (Bigelow, 1918, p. 420) for concluding that identification of Eschscholtz's old species is no more doubtful than it is for "most of the early descriptions of Siphonophorae and Medusae", in fact, Eschscholtz's figure (1829, Pl. 12, Fig. 7) agrees very well with the form subsequently described by Costa (1836) as *bipartita*[2], by Leuckart (1853) as *Diphyes acuminata* and by Kölliker (1853) as *Diphyes sieboldii.*

In short, we see no reason to alter the earlier view that "when the probability that identification of an old name is correct, is as strong as in the present case, it should be used, until some actual reason to the contrary is adduced" (Bigelow, 1918, p. 421).

In deciding what degree of completeness or accuracy, one should expect from the older descriptions, it is perhaps pertinent that one of the most diagnostic features of *C. appendiculata*, namely that the left lateral ridge arises some distance below the apex, was generally overlooked until 1911.

The present series is chiefly interesting (from the taxonomic standpoint) as cumulative evidence of the constancy of several minor characters, which have already been shown to be diagnostic of the species; namely the origin of the left ridge considerably below the apex; the twisting of the apical extremity of the right lateral ridge; the suppression of all but the basal sector of the dorsal ridge; and the truncate outlines of the hydroecium. So far, no significant variant has been recorded in any these respects.

## EUDOXOIDES Huxley 1859.

This generic name was proposed by Huxley (1859) for an eudoxid, which (as now seems certain) belonged to his *Diphyes mitra* (Browne, 1926, p. 74; Totton, 1932, p. 346, 358).

### EUDOXOIDES SPIRALIS Bigelow 1911.

*Diphyes spiralis*, Bigelow, 1911b, p. 249, Pl. 7, Fig. 4, Pl. 8, Fig. 1, 2, Pl. 9, Fig. 3, Pl. 11, Fig. 4; 1913, p. 76.

*Muggiaea spiralis*, Moser, 1925, p. 108, Pl. 1, Fig. 6—11; Browne, 1926, p. 59.

*Eudoxoides spiralis*, Totton, 1932, p. 360; Leloup, 1933, p. 34; 1934, p. 25.

[1] The catches were estimated after counting 0.19 and 0.29 of the actual catches from St. 92 (65 m wire) and St. 233 (25 m wire), respectively.

[2] The *Salpa (bipartita) lanceolata bipartita* of Bory de St. Vincent (1804) was *Diphyes dispar.*

## Material.

St. 10. 37°21′ N., 16°45′ E. 15. XII. 1908.
Y. 25 m w. 2 nectoph.; 1 eudox.
Y. 65 m w. 1 nectoph.
Y. 600 m w. 18 nectoph.
St. 11. 36°57′ N., 18°16′ E. 16. XII. 1908.
Y. 25 m w. 234 nectoph.
St. 13. 39°43′ N., 17°30′ E. 19. XII. 1908.
Y. 1000 m w. 1 eudox.?
St. 26. 40°40′ N., 13°59′ E. 18. I. 1909.
Y. 300 m w. 1 nectoph.
St. 29. 40°47′ N., 12°55′ E. 20. I. 1909.
Y. 200 m w. 1 nectoph.
St. 39. 39°41′ N., 10°02′ E. 1. II. 1909.
Y. 25 m w. 7 nectoph.; 3 gonoph.
St. 40. 39°10′ N., 9°40′ E. 1. II. 1909.
Y. 65 m w. 20 nectoph.; 3 bracts; 3 gonoph.
St. 42. 38°58′ N., 9°37′ E. 2. II. 1909.
Y. 300 m w. 1 nectoph.
St. 43. 38°14′ N., 8°42′ E. 3. II. 1909.
Y. 65 m w. 18 nectoph.; 4 eudox.; 6 bracts; 16 gonoph.
St. 46. 37°17′ N., 6°00′ E. 7. II. 1909.
Y. 65 m w. 11 nectoph.; 1 eudox.; 9 bracts; 8 gonoph.
Y. 300 m w. 2 nectoph.
Y. 600 m w. 46 nectoph.; 51 eudox.; 45 gonoph.
St. 47. 36°55′ N., 3°12′ E. 10. II. 1909.
Y. 65 m w. 62 nectoph.; 6 eudox.; 36 bracts; 64 gonoph.
Y. 300 m w. 35 nectoph.; 9 eudox.; 10 bracts; 19 gonoph.
St. 50. 37°02′ N., 1°17′ E. 17. II. 1909.
Y. 25 m w. 121 nectoph., 86 eudox.; 101 gonoph.
Y. 65 m w. 52 nectoph.; 24 eudox.; 25 gonoph.
Y. 300 m w. 19 nectoph.; 9 eudox.; 3 gonoph.
Y. 600 m w. 9 nectoph.
Y. 1600 m w. 7 nectoph.; 2 eudox.; 7 gonoph.
St. 51. 36°27′ N., 0°37′ W. 18. II. 1909.
Y. 300 m w. 12 nectoph.; 1 eudox.; 2 gonoph.
St. 55. 36°46′ N., 2°18′ W. 19. II. 1909.
Y. 25 m w. 2 nectoph.; 1 bract.
Y. 65 m. w. 4 nectoph.
St. 57. 36°40′ N., 3°30′ W. 20. II. 1909.
Y. 200 m w. 2 nectoph.
St. 58. 36°36′ N., 4°24′ W. 20. II. 1909.
Y. 65 m w. 1 nectoph.; 1 gonoph.
St. 59. 36°02′ N., 4°24′ W. 21. II. 1909.
Y. 25 m w. 5 nectoph.; 3 gonoph.
Y. 100 m w. 1 nectoph.
Y. 500 m w. 1 nectoph.
Y. 1200 m w. 2 nectoph.
St. 65. 35°53′ N., 7°26′ W. 24. II. 1909.
Y. 65 m w. 2 nectoph.
Y. 1600 m w. 1 nectoph.
St. 69. 36°13′ N., 9°44′ W. 28. II. 1909.
Y. 65 m w. 1 nectoph.
St. 89. 36°28′ N., 8°22′ W. 18. VI. 1910.
Y. 65 m w. 5 nectoph.
Y. 1000 m w. 10 nectoph.; 1 eudox.
St. 91. 35°53′ N., 7°26′ W. 18. VI. 1910.
Y. 300 m w. 64 nectoph.
Y. 1600 m w. 3 nectoph.
St. 95. 35°57′ N., 6°00′ W. 23. VI. 1910.
Y. 65 m w. 140 nectoph.
St. 99. 36°02′ N., 5°16′ W. 23. VI. 1910.
Y. 300 m w. 1 nectoph.
St. 106. 36°33′ N., 2°00′ W. 25. VI. 1910.
Y. 65 m w. 94 nectoph.
Y. 300 m w. 1 nectoph.; 1 eudox.
Y. 1200 m w. 2 nectoph.
St. 107. 36°18′ N., 1°14′ W. 25. VI. 1910.
Y. 65 m w. 12 nectoph.; 1 bract.
Y. 300 m w. 3 nectoph.
Y. 2000 m w. 4 nectoph.
St. 108. 36°03′ N., 0°27′ W. 25. VI. 1910.
Y. 65 m w. 4 nectoph.
St. 112. 35°56′ N., 2°15′ E. 27. VI. 1910.
Y. 25 m w. 74 nectoph.; 1 eudox.; 3 gonoph.
Y. 65 m w. 117 nectoph.; 43 eudox.; 29 bracts; 137 gonoph.
Y. 300 m w. 10 nectoph.; 1 gonoph.
St. 113. 36°53′ N., 3°09′ E. 28. VI. 1910.
Y. 300 m w. 1 nectoph.
St. 115. 38°17′ N., 4°11′ E. 28. VI. 1910.
Y. 25 m w. 18 nectoph.
Y. 65 m w. 88 nectoph.; 1 eudox.; 1 gonoph.
Y. 300 m w. 15 nectoph.
Y. 2000 m w. 21 nectoph.
St. 116. 39°27′ N., 5°26′ E. 29. VI. 1910.
Y. 25 m w. 90 nectoph.; 1 eudox.; 6 gonoph.
Y. 65 m w. 5 nectoph.
Y. 300 m w. 7 nectoph.
St. 118. 41°00′ N., 6°43′ E. 30. VI. 1910.
Y. 25 m w. 18 nectoph.
Y. 65 m w. 18 nectoph.
Y. 300 m w. 12 nectoph.
St. 120. 42°31′ N., 7°41′ E. 1. VII. 1910.
Y. 300 m w. 2 nectoph.
St. 122. 43°50′ N., 8°34′ E. 2. VII. 1910.
Y. 1200 m w. 1 nectoph.
St. 123. 44°14′ N., 8°55′ E. 3. VII. 1910.
Y. 10 m w. 4 nectoph.
Y. 25 m w. 10 nectoph.
Y. 65 m w. 108 nectoph.; 2 eudox.; 1 gonoph.
Y. 300 m w. 7 nectoph.; 1 bract.
St. 124. 44°20′ N., 9°05′ E. 3. VII. 1910.
Y. 65 m w. 10 nectoph.
St. 126. 42° 43′ N., 9°50′ E. 10. VII. 1910.
Y. 25 m w. 2 nectoph.
St. 129. 40°05′ N., 11°31′ E. 12. VII. 1910.
Y. 25 m w. 2 nectoph.
Y. 600 m w. 1 nectoph.
Y. 1000 m w. 1 nectoph.
C. 3500 m w. 1 nectoph.
St. 130. 39°35′ N., 11°20′ E. 13. VII. 1910.
Y. 25 m w. 4 nectoph.
St. 131. 38°36′ N., 11°00′ E. 13. VII. 1910.
Y. 1000 m w. 2 nectoph.
St. 132. 38°57′ N., 9°47′ E. 14. VII. 1910.
Y. 25 m w. 1 nectoph.
St. 133. 38°18′ N., 9°59′ E. 14. VII. 1910.
Y. 600 m w. 5 nectoph.
St. 134. 37°37′ N., 10°17′ E. 15. VII. 1910.
Y. 25 m w. 11 nectoph.
Y. 300 m w. 6 nectoph.
St. 137. 37°17′ N., 10°56′ E. 19. VII. 1910.
Y. 25 m w. 78 nectoph.; 3 gonoph.
Y. 250 m w. 9 nectoph.
St. 138. 37°37′ N., 11°25′ E. 19. VII. 1910.
Y. 25 m w. 185 nectoph.; 2 eudox.; 12 gonoph.
Y. 300 m w. 7 nectoph.
Y. 1000 m w. 12 nectoph.
St. 139. 37°57′ N., 11°54′ E. 20. VII. 1910.
Y. 25 m w. 9 nectoph.
St. 141. 36°42′ N., 13°34′ E. 20. VII. 1910.
Y. 25 m w. 3 nectoph.
St. 142. 35°44′ N., 15°07′ E. 22. VII. 1910.
Y. 25 m w. 99 nectoph.
St. 143. 35°18′ N., 16°25′ E. 22. VII. 1910.
Y. 300 m w. 5 nectoph.
Y. 1000 m w. 8 nectoph.
St. 144. 34°31′ N., 18°40′ E. 23. VII. 1910.
Y. 25 m w. 1 nectoph.
Y. 300 m w. 7 nectoph.
St. 145. 32°38′ N., 19°02′ E. 25. VII. 1910.
Y. 25 m w. 2 nectoph.
Y. 300 m w. 215 nectoph.
St. 147. 31°35′ N., 19°02′ E. 25. VII. 1910.
Y. 1000 m w. 22 nectoph.
St. 152. 33°11′ N., 21°44′ E. 27. VII. 1910.
Y. 25 m w. 7 nectoph.
Y. 300 m w. 90 nectoph.
Y. 1000 m w. 12 nectoph.

St. 154. 32°10′ N., 26°46′ E. 29. VII. 1910.
Y. 300 m w. 1 nectoph.
St. 156. 32°16′ N., 26°03′ E. 30. VII. 1910.
Y. 600 m w. 2 nectoph.
Y. 1000 m w. 7 nectoph.
St. 158. 34°23′ N., 27°57′ E. 31. VII. 1910.
Y. 300 m w. 7 nectoph.
St. 160. 35°59′ N., 28°14′ E. 1. VIII. 1910.
Y. 25 m w. 3 nectoph.
Y. 300 m w. 3 nectoph.
Y. 1000 m w. 1 nectoph.
C. 4000 m w. 1 nectoph.
St. 163. 37°52′ N., 26°22′ E. 2. VIII. 1910.
Y. 25 m w. 3 nectoph.
Y. 200 m w. 25 nectoph.
St. 179. 40°02′ N., 25°55′ E. 13. VIII. 1910.
Y. 65 m w. 12 nectoph.
St. 181. 38°49′ N., 25° 09′ E. 13. VIII. 1910.
Y. 65 m w. 3 nectoph.
St. 182. 38°13′ N., 24°48′ E. 14. VIII. 1910.
Y. 10 m w. 2 nectoph.
Y. 65 m w. 9 nectoph.
Y. 600 m w. 11 nectoph.
St. 183. 37°52′ N., 23°09′ E. 16. VIII. 1910.
Y. 65 m w. 26 nectoph.
Y. 300 m w. 2 nectoph.
St. 186. 37°57′ N., 19°51′ E. 17. VIII. 1910.
Y. 65 m w. 9 nectoph.; 1 gonoph.
Y. 300 m w. 2 nectoph.
Y. 1200 m w. 6 nectoph.
St. 187. 37°54′ N., 18°02′ E. 18. VIII. 1910.
Y. 300 m w. 2 nectoph.
St. 189. 37°44′ N., 15°58′ E. 19. VIII. 1910.
Y. 300 m w. 4 nectoph.
Y. 1000 m w. 5 nectoph.
St. 190. 37°51′ N., 15°19′ E. 19. VIII. 1910.
Y. 25 m w. 60 nectoph.; 1 bract; 6 gonoph.
St. 192. 38°07′ N., 15°35′ E. 20. VIII. 1910.
Y. 25 m w. 6 nectoph.; 2 gonoph.
Y. 300 m w. 1 nectoph.
St. 193. 38°15′ N., 15°39′ E. 21. VIII. 1910.
Y. 10 m w. 54 nectoph.; 2 eudox.; 5 gonoph.
St. 194. 38°33′ N., 15° 29′ E. 21. VIII. 1910.
Y. 25 m w. 1 nectoph.
Y. 1200 m w. 10 nectoph.
St. 195. 39°02′ N., 14°55′ E. 21. VIII. 1910.
Y. 300 m w. 3 nectoph.
St. 197. 40°34′ N., 13°36′ E. 24. VIII. 1910.
Y. 300 m w. 1 nectoph.
St. 199. 39°32′ N., 10°49′ E. 25. VIII. 1910.
Y. 300 m w. 15 nectoph.
Y. 1000 m w. 5 nectoph.
St. 202. 38°59′ N., 9°25′ E. 26. VIII. 1910.
Y. 300 m w. 1 nectoph.
St. 204. 38°52′ N., 7°43′ E. 27. VIII. 1910.
Y. 25 m w. 3 nectoph.
Y. 65 m w. 7 nectoph.; 1 gonoph.
Y. 300 m w. 1 nectoph.
Y. 1000 m w. 7 nectoph.
St. 205. 39°16′ N., 5°52′ E. 27. VIII. 1910.
Y. 25 m w. 4 nectoph.
St. 206. 39°32′ N., 5°15′ E. 28. VIII. 1919.
Y. 300 m w. 18 nectoph.; 1 gonoph.
Y. 2000 m w. 21 nectoph.; 2 gonoph.
St. 207. 39°58′ N., 3°41′ E. 28. VIII. 1910.
Y. 25 m w. 6 nectoph.
Y. 65 m w. 2 nectoph.
St. 208. 40°18′ N., 3°20′ E. 29. VIII. 1910.
Y. 25 m w. 3 nectoph.
St. 209. 40°34′ N., 3°03′ E. 29. VIII. 1910.
C. 35-0 m w. 1 nectoph.
C. 150 m w. 4 nectoph.; 1 gonoph.
Y. 25 m w. 2 nectoph.
Y. 100 m w. 1 nectoph.
Y. 2000 m w. 1 nectoph.
St. 218. 36°54′ N., 2°57′ E. 2. IX. 1910.
Y. 25 m w. 4 nectoph.
St. 221. 35°44′ N., 0°53′ W. 4. IX. 1910.
Y. 25 m w. 32 nectoph.; 4 gonoph.
St. 223. 36°13′ N., 1°28′ W. 5. IX. 1910.
Y. 25 m w. 2 nectoph.
St. 225. 36°35′ N., 3°00′ W. 6. IX. 1910.
Y. 300 m w. 1 nectoph.; 1 eudox.; 1 bract; 2 gonoph.
St. 232. 36°28′ N., 9°06′ W. 9. IX. 1910.
Y. 25 m w. 17 nectoph.
Y. 300 m w. 3 nectoph.
St. 278. 38°11.5′ N., 15°37.5′ E. 22. II. 1911.
S. 15 m w. 79 nectoph.; 3 eudox.; 4 bracts; 6 gonoph.
St. 279. 38°11.5′ N., 15°36.5′ E. 23. II. 1911.
S. 30 m w. 30 nectoph.; 4 eudox.; 5 bracts; 10 gonoph.
St. 280. 38°11′ N., 15°36.5′ E. 25. II. 1911.
S. 15 m w. 23 nectoph.; 3 eudox.; 6 bracts; 5 gonoph.
St. 281. 38°15′ N., 15°37.5′ E. 1. III. 1911.
S. 10 m w. 11 nectoph.
S. 30 m w. 1 nectoph.
S. 40 m w. 46 nectoph.; 2 bracts; 5 gonoph.
St. 282. 38°12′ N., 15°37′ E. 8. III. 1911.
S. 40 m w. 191 nectoph.; 5 eudox.; 18 bracts; 43 gonoph.
St. 283. 38°12′ N., 15°37.5′ E. 12. III. 1911.
S. 40 m w. 52 nectoph.; 1 eudox.; 2 bracts; 9 gonoph.
St. 297. 33°10′ N., 25°03′ E. 25. VI. 1911.
S. 28 m w. 3 nectoph.
St. 298. 34°20′ N., 21°10′ E. 26. VI. 1911.
S. 38 m w. 1 nectoph.

The first account of this species (Bigelow, 1911 b, p. 251) referred it to *Diphyes*, because "in two specimens the stem bore a very small bud which was apparently the forerunner of a posterior nectophore". This interpretation seems, however, to have been in error, for neither Moser, Browne, Totton nor Leloup found either inferior nectophores, or buds for the latter in any of the superior nectophores that they have examined. And as they are equally lacking in the "Thor" series, Moser (1925, p. 109) was no doubt correct in concluding that *spiralis* is monophyid.

The spirally twisted nectophores, and gonophores, are so striking to the eye as to make this the most easily recognized of all Diphyinae. The present specimens add nothing to the detailed accounts that have previously appeared of the nectophore (Bigelow, 1911 b; Moser, 1925) or of the eudoxid (Moser, 1925; Browne, 1926; Totton, 1932).

## LENSIA Totton 1932.

This genus was proposed by Totton (1932, p. 363) for certain small diphyids, which agree in the following combination of characters:— Superior nectophore pentagonal, without baso-lateral or baso-dorsal teeth; with a very shallow hydroecium; with a short divided mouth-plate; without commissures from the radial canals; inferior nectophore (where known), small and fragile. Besides the type species (*Diphyes subtiloides* Lens and Van Riemsdijk 1908), Totton referred the following to *Lensia*:— *Diphyes subtilis* Chun 1886; *D. fowleri* Bigelow 1911; *D. truncata* Sars 1846[1]; *Galeolaria campanella* Moser 1925; *G. multicristata* Moser 1925 (incl. *D. bigelowi* Browne 1926). Leloup in 1933 also referred to it a new species, *L. grimaldii*, which, however, he later (1934) considered a variety of *L. multicristata*.

Although the characters separating these species are for the most part such as might be classed as "minor", yet they are so clear-cut that specific diagnosis is not only remarkably precise, but easy for well preserved material. One species, *campanella*, is set apart by the spiral twisting of the superior nectophore. This is not represented in the "Thor" collection but has been studied by Totton (1932) as well as by its discoverer. A second species, *multicristata*, or perhaps pair of species (incl. *grimaldii*), is delimited by the large number of longitudinal ridges (7 or more) and by deep concavity of the basal margin of the ventral facet. The remaining species resemble each other closely in general appearance, but are separable by details of conformation, as summarized in the following key.

Superior nectophore.

1. Spirally twisted ........ *campanella*
   Not spirally twisted ........ 2
2. Apex rounded, somatocyst with a thread-like stalk much longer than its globular terminal portion, *subtilis*
   Apex pointed; somatocyst either without stalk, or if stalked, stalk is much shorter than terminal portion, 3
3. With 7 or more longitudinal ridges ........ *multicristata* incl. *grimaldii*
   With 5 ridges only ........ 4
4. Somatocyst globular, lying wholly below the level of the opening of the nectosac ........ *fowleri*
   Somatocyst ovate or fusiform, extending apically beyond the level of the opening of the nectosac .. 5
5. Dorso-basal angle somewhat produced, latero-basal margin of hydroecial portion only slightly oblique to general longitudinal axis of bell (Fig. 47) ........ *conoidea*
   Dorso-basal angle not produced, latero-basal margin of hydroecial portion strongly oblique to longitudinal axis of bell (Fig. 47) ........ *subtiloides*

Totton (1932, p. 370) has also given brief accounts of certain superior nectophores, resembling *conoidea* in general, but apparently differing from that species in minor features. However, as they were not in good enough condition for critical study, nothing further can be said about them.

Inferior nectophore. Among the 5 species, inferior bells of which have been described, *conoidea*[2] is set apart by the considerable length and bifid outline of the basal wing (p. 52, Fig. 34). The inferior bells of *campanella*, *multicristata*, *subtilis*, and *subtiloides* agree in the shortness of the basal wing and in the fact that its outline is entire. Judging from the illustrations so far published (see also p. 58), it seems that the inferior bell of *multicristata*[3] is identifiable by the fact that the lateral ridges terminate some distance above the oral margin, as is also the case in the superior nectophore. In *campanella*[4], the lateral ridges are lacking. In *subtilis*[5] and *subtiloides*[6] lateral ridges are present, but in *subtiloides* the apical outline of the nectosac is transversely truncate (as it is also in *campanella* and *conoidea*), whereas it is narrowly rounded in *subtilis* (cf. Totton, 1932, Fig. 34 B, with Fig. 32 B).

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[1] As pointed out on page 49, this name was preoccupied, and the name *L. conoidea* Keferstein and Ehlers 1860 must be substituted.

[2] Inferior nectophore observed attached to the superior (Sars, 1846).

[3] Buds were present among the "Thor" series (p. 58).

[4] Loose lower bell, probably *campanella*, described by Moser (1925, p. 154, Taf. 4, fig. 2) and figured by Totton (1932, Fig. 35 B).

[5] Inferior nectophore repeatedly observed still connected with the superior bell (Lens and Van Riemsdijk, 1908, p. 47; Moser, 1925, p. 164; Totton, 1932, Fig. 34).

[6] Bud for the inferior nectophores seen by Lens and Van Riemsdijk (1908, p. 48), and loose inferior bells, no doubt of this parentage, recorded by Totton (1932, p. 364).

The only species of *Lensia*, in which the cormidia and free eudoxids have been seen, are *conoidea* (Sars 1846; Totton, 1932, p. 367) and *subtiloides* (Totton, p. 366, Fig. 33). The "Thor" collection adds nothing in this respect.

## LENSIA CONOIDEA Keferstein and Ehlers 1860.

Figs. 27—35, 47.

*Diphyes truncata*, Sars, 1846, p. 41—45, Pl. 7, Fig. 1—15; Bigelow, 1913, p. 73—75, Textfig. 2, Pl. 6, Fig. 3—5. (non *Diphyes truncata* Quoy and Gaimard, 1834, p. 97, Pl. 5, Fig. 21—23).

*Diphyes conoidea*, Keferstein and Ehlers, 1860, p. 260; 1861, p. 16, Pl. 5, Fig. 6—7.

*Galeolaria truncata*, Moser, 1925, p. 154, Pl. 3, Fig. 7—8, Pl. 4, Fig. 3—4.

*Lensia truncata*, Totton, 1932, p. 340; Lelóup, 1933, p. 36; 1934, p. 42.

### Material.

St. 30. 41°15′ N., 11°55′ E. 21. I. 1909.
Y. 300 m w. 11 sup. nectoph.; 19 inf. nectoph.
St. 31. 41°44′ N., 10°52′ E. 21. I. 1909.
Y. 65 m w. 38 sup. nectoph.; 40 inf. nectoph.
Y. 200 m w. 132 sup. nectoph.; 91 inf. nectoph.
Y. 600 m w. 103 sup. nectoph.; 47 inf. nectoph.
Y. 1400 m w. 82 sup. nectoph.; 49 inf. nectoph.
St. 33. 43°04′ N., 9°35′ E. 22. I. 1909.
Y. 65 m w. 1 sup. nectoph.
St. 34. 43°27′ N., 8°16′ E. 23. I. 1909.
Y. 25 m w. 2 sup. nectoph.; 2 inf. nectoph.
Y. 65 m w. 1 sup. nectoph.; 1 inf. nectoph.
Y. 200 m w. 2 sup. nectoph.
St. 35. 43°36′ N., 7°36′ E. 29. I. 1909.
Y. 300 m w. 2 sup. nectoph.
Y. 700 m w. 9 sup. nectoph.; 2 inf. nectoph.
S. 1000 m w. 7 sup. nectoph.; 5 inf. nectoph.
Y. 1600 m w. 6 + sup. nectoph.; 6 + inf. nectoph.
C. 2500 m w. 8 sup. nectoph.; 2 inf. nectoph.
St. 36. 42°49′ N., 6°54′ E. 30. I. 1909.
Y. 300 m w. 92 sup. nectoph.; 74 inf. nectoph.
St. 38. 40°45′ N., 9°50′ E. 31. I. 1909.
Y. 65 m w. 1 sup. nectoph.
St. 39. 39°41′ N., 10°02′ E. 1. II. 1909.
Y. 25 m w. 8 sup. nectoph.; 4 inf. nectoph.
Y. 300 m w. 1 sup. nectoph.
St. 40. 39°10′ N., 9°40′ E. 1. II. 1909.
Y. 65 m w. 6 sup. nectoph.; 1 inf. nectoph.
St. 42. 38°58′ N., 9°37′ E. 2. II. 1909.
Y. 300 m w. 1 sup. nectoph.
St. 43. 38°14′ N., 8°42′ E. 3. II. 1909.
Y. 65 m w. 5 sup. nectoph.; 1 inf. nectoph.
St. 46. 37°17′ N., 6°00′ E. 7. II. 1909.
Y. 65 m w. 6 sup. nectoph.
Y. 300 m w. 1 sup. nectoph.
Y. 600 m w. 4 sup. nectoph.
St. 47. 36°55′ N., 3°12′ E. 10. II. 1909.
Y. 300 m w. 1 sup. nectoph.
St. 50. 37°02′ N., 1°17′ E. 17. II. 1909.
Y. 25 m w. 1 sup. nectoph.
Y. 65 m w. 2 sup. nectoph.
Y. 600 m w. 1 sup. nectoph.
Y. 1600 m w. 3 sup. nectoph.
St. 51. 36°27′ N., 0°37′ W. 18. II. 1909.
Y. 300 m w. 3 sup. nectoph.
St. 57. 36°40′ N., 3°30′ W. 20. II. 1909.
Y. 200 m w. 5 sup. nectoph.
St. 58. 36°36′ N., 4°24′ W. 20. II. 1909.
Y. 65 m w. 1 sup. nectoph.
Y. 100 m w. 5 sup. nectoph.
St. 59. 36°02′ N., 4°24′ W. 21. II. 1909.
Y. 100 m w. 9 sup. nectoph.
Y. 500 m w. 2 sup. nectoph.
Y. 1200 m w. 15 sup. nectoph.
St. 61. 35°57′ N., 5°35′ W. 21. II. 1909.
Y. 600 m w. 3 sup. nectoph.
St. 65. 35°53′ N., 7°26′ W. 24. II. 1909.
Y. 600 m w. 8 sup. nectoph.
St. 69. 36°13′ N., 9°44′ W. 28. II. 1909.
Y. 25 m w. 5 sup. nectoph.; 1 inf. nectoph.
Y. 65 m w. 10 sup. nectoph.; 3 inf. nectoph.
Y. 300 m w. 195 sup. nectoph.; 5 inf. nectoph.
Y. 600 m w. 56 sup. nectoph.; 1 inf. nectoph.
St. 71. 39°35′ N., 9°45′ W. 4. III. 1909.
Y. 300 m w. 317 sup. nectoph.; 190 inf. nectoph.
Y. 600 m w. 3 sup. nectoph.
Y. 1600 m w. 7 sup. nectoph.
St. 74. 44°21′ N., 7°55′ W. 9. III. 1909.
Y. 300 m w. 239 sup. nectoph.; 107 inf. nectoph.
Y. 600 m w. 43 sup. nectoph.; 4 inf. nectoph.
St. 75. 45°37′ N., 7°03′ W. 9. III. 1909.
Y. 300 m w. 227 sup. nectoph.; 149 inf. nectoph.
Y. 600 m w. 50 sup. nectoph.; 10 inf. nectoph.
C. 4300 m w. 1 sup. nectoph.; 1 inf. nectoph.
St. 76. 47°01′ N., 5°48′ W. 10. III. 1909.
Y. 600 m w. 39 sup. nectoph.; 18 inf. nectoph.
Y. 1600 m w. 11 sup. nectoph.
St. 79. 47°30′ N., 6°43′ W. 13. VI. 1910.
Y. 65 m w. 6 sup. nectoph.; 3 inf. nectoph.
St. 80. 46°17′ N., 7°31′ W. 13. VI. 1910.
Y. 25 m w. 1 sup. nectoph.
Y. 300 m w. 21 sup. nectoph.; 15 inf. nectoph.
St. 89. 36°28′ N., 8°22′ W. 18. VI. 1910.
Y. 1000 m w. 130 sup. nectoph.; 1 inf. nectoph.
St. 95. 35°57′ N., 6°00′ W. 23. VI. 1910.
Y. 25 m w. 1 sup. nectoph.
Y. 300 m w. 14 sup. nectoph.
St. 106. 36°33′ N., 2°00′ W. 25. VI. 1910.
Y. 300 m w. 1 sup. nectoph.
Y. 1200 m w. 60 sup. nectoph.
St. 107. 36°18′ N., 1°14′ W. 25. VI. 1910.
Y. 65 m w. 1 sup. nectoph.
Y. 300 m w. 2 sup. nectoph.
Y. 2000 m w. 12 sup. nectoph.
St. 115. 38°17′ N., 4°11′ E. 28. VI. 1910.
Y. 300 m w. 4 sup. nectoph.
Y. 2000 m w. 115 sup. nectoph.; 23 inf. nectoph.
St. 116. 39°27′ N., 5°26′ E. 30. VI. 1910.
Y. 300 m w. 10 sup. nectoph.
St. 118. 41°00′ N., 6°43′ E. 1. VII. 1910.
Y. 300 m w. 7 sup. nectoph.
St. 120. 42°31′ N., 7°41′ E. 1. VII. 1910.
Y. 300 m w. 10 sup. nectoph.
St. 122. 43°50′ N., 8°34′ E. 2. VII. 1910.
Y. 600 m w. 52 sup. nectoph.; 16 inf. nectoph.
Y. 1200 m w. 397 sup. nectoph.; 121 inf. nectoph.
St. 123. 44°14′ N., 8°55′ E. 3. VII. 1910.
Y. 300 m w. 8 sup. nectoph.; 1 inf. nectoph.
St. 125. 43°54′ N., 9°13′ E. 9. VII. 1910.
Y. 300 m w. 13 sup. nectoph.; 1 inf. nectoph.
St. 126. 42°43′ N., 9°50′ E. 10. VII. 1910.
Y. 25 m w. 1 sup. nectoph.

St. 129. 40°05′ N., 11°31′ E. 12. VII. 1910.
Y. 1000 m w. 1 sup. nectoph.; 1 inf. nectoph.
St. 132. 38°57′ N., 9°47′ E. 14. VII. 1910.
Y. 300 m w. 1 + sup. nectop.
St. 133. 38°18′ N., 9°59′ E. 14. VII. 1910.
Y. 300 m w. 14 sup. nectoph.; 1 inf. nectoph.
St. 137. 37°17′ N., 10°56′ E. 19. VII. 1910.
Y. 250 m w. 7 sup. nectoph.; 6 inf. nectoph.
St. 138. 37°37′ N., 11°25′ E. 19. VII. 1910.
Y. 1000 m w. 4 sup. nectoph.
St. 139. 37°57′ N., 11°54′ E. 20. VII. 1910.
Y. 800 m w. 2 sup. nectoph.
St. 156. 32°16′ N., 26°03′ E. 30. VII. 1910.
Y. 600 m w. 10 sup. nectoph.
Y. 1000 m w. 1 sup. nectoph.
St. 160. 36°59′ N., 28°14′ E. 1. VIII. 1910.
Y. 25 m w. 1 sup. nectoph.; 1 inf. nectoph.
St. 163. 37°52′ N., 26°22′ E. 3. VIII. 1910.
Y. 25 m w. 1 sup. nectoph.; 1 inf. nectoph.
St. 174. 40°54′ N., 28°63′ E. 11. VII. 1910.
Y. 65 m w. 15 sup. nectoph.
St. 175. 40°48′ N., 27°59′ E. 11. VII. 1910.
Y. 100 m w. 445 sup. nectoph.; 62 inf. nectoph.
Y. 400 m w. 210 sup. nectoph.; 66 inf. nectoph.
Y. 1200 m w. 187 sup. nectoph.; 105 inf. nectoph.
St. 181. 38°49′ N., 25°09′ E. 13. VIII. 1910.
Y. 65 m w. 1 sup. nectoph.
St. 186. 37°57′ N., 19°51′ E. 17. VIII. 1910.
Y. 1200 m w. 1 sup. nectoph.
St. 194. 38°33′ N., 15°29′ E. 21. VIII. 1910.
Y. 10 m w. 3 sup. nectoph.; 9 inf. nectoph.
Y. 1200 m w. 62 sup. nectoph.
St. 199. 39°32′ N., 10°49′ E. 25. VIII. 1910.
Y. 300 m w. 3 sup. nectoph.
St. 204. 38°52′ N., 7°43′ E. 27. VIII. 1910.
Y. 300 m w. 24 sup. nectoph.; 14 inf. nectoph.
St. 206. 39°32′ N., 5°15′ E. 28. VIII. 1910.
Y. 300 m w. 4 sup. nectoph.; 1 + inf. nectoph.
Y. 1000 m w. 6 sup. nectoph.
Y. 2000 m w. 104 sup. nectoph.; 53 inf. nectoph.
St. 209. 40°34′ N., 3°03′ E. 29. VIII. 1910.
Y. 2000 m w. 104 sup. nectoph.; 21 inf. nectoph.
St. 217. 38°01′ N., 1°48′ E. 1. IX. 1910.
Y. 300 m w. 1 sup. nectoph.
St. 222. 35°53′ N., 0°57′ W. 4. IX. 1910.
Y. 300 m w. 2 sup. nectoph.
St. 223. 36°13′ N., 1°28′ W. 5. IX. 1910.
Y. 300 m w. 3 sup. nectoph.; 1 inf. nectoph.
St. 228. 36°02′ N., 5°06′ W. 7. IX. 1910.
Y. 300 m w. 2 sup. nectoph.
St. 229. 35°51′ N., 5°58′ W. 8. IX. 1910.
Y. 300 m w. 14 sup. nectoph.
St. 242. 46°19′ N., 6°48′ W. 16. IX. 1910.
C. 4350 m w. 1 sup. nectoph.
St. 245. 47°14′ N., 6°02′ W. 17. IX. 1910.
Y. 250 m w. 1 sup. nectoph.

Identification doubtful:—
St. 210. 41°10′ N., 2°23′ E. 30. VIII. 1910.
Y. 600 m w. 1 sup. nectoph.

In recent discussions of this diphyid, the fact seems to have been overlooked that twelve years before Sars described his *Diphyes truncata*, Quoy and Gaimard had used this same name for the bell of quite a different siphonophore[1]. For this reason (to comply with the International Rules of Zoological Nomenclature), the specific name *truncata* cannot be used for Sars's species. Fortunately, however, there is no need of a new name in this case, for in 1860, Keferstein and Ehlers redescribed and, in 1861, excellently figured (apparently without knowledge of Sars's account) a Mediterranean diphyid as *D. conoidea*, which was undoubtedly identical with Sars's Norwegian *truncata*. Consequently, *conoidea* must be substituted for *truncata* as the specific name for Sars's species, and *truncata* be reserved pending the time (if ever) when some actual siphonophore is found with which Quoy and Gaimard's account and pictures can be identified with reasonable probability.

Successive studies of recent collections have shown that *conoidea* is one of the most easily recognizable of diphyids, for its distinctive characters are precise, the mature bells grow to a considerable size (maximum recorded length, 28 mm. for the superior nectophore, 17 mm. for the inferior nectophore), and the gelatinous substance is so firm and the subumbral musculature so strong that the number and location of the ridges, with the outlines of the facets and of the basal parts of the bells are easy to trace even on poorly preserved material. The most distinctive characters of the species were, in fact, stated and figured so adequately both by Sars and by Keferstein and Ehlers, that there is little room for amplification, except as regards variations in the length and the form of the somatocyst, in the depth of the hydroecial cavity (if any), and in the precise basal outline of the superior nectophore.

These apparently minor characters call for discussion, because it is their constancy which shows the closely allied forms, *L. fowleri* and *L. subtiloides*, to be specifically distinct, as Browne (1926) and Totton (1932) have recently shown, and not mere variants of *conoidea*.

Superior Nectophore. In the general form of the bell, the number of ridges (5 from apex to base

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[1] Quoy and Gaimard's *D. truncata* was apparently the superior nectophore of some abylid, not of a diphyid. But it has not been possible to identify it with any known species.

Fig. 27—29), in the outlines of the 5 facets, in the absence of basal teeth, and in the transversely truncate outlines of the base with the point of origin of the somatocyst and of the stem lying below the level of the opening of the nectosac (or at least no higher than the latter), no variations appear in the Atlantic and Pacific specimens we have examined, other than such as are obviously results of differences in rigidity, or of contraction in preservation. Median grooves often seen in the dorso-lateral and ventro-lateral facets (Fig. 29, 33), may simply be contraction phenomena, for they do not appear in Sars's illustration; and the various minor grooves in the basal portion (Fig. 27) certainly are. It is interesting, in passing, that the ventral facet never (in our experience) shows any such contractions, probably because of the thickness of jelly which separates it from the musculature. The shape and flatness of this facet (Fig. 28), and the rectangular outline of base (Fig. 29) are the readiest field marks to the species.

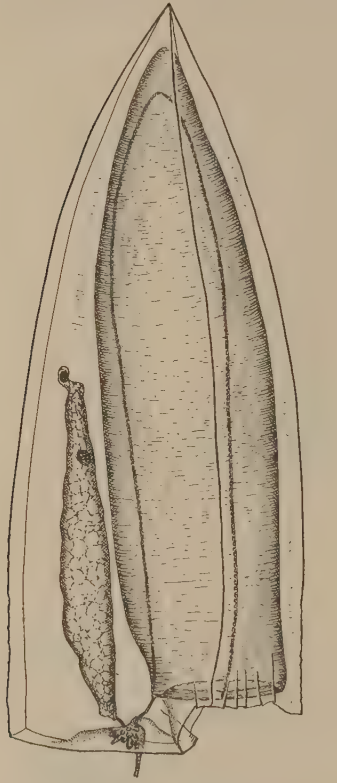
Fig. 27. *Lensia conoidea*; lateral view of superior nectophore, 14.5 mm. long, from "Thor" St. 36.

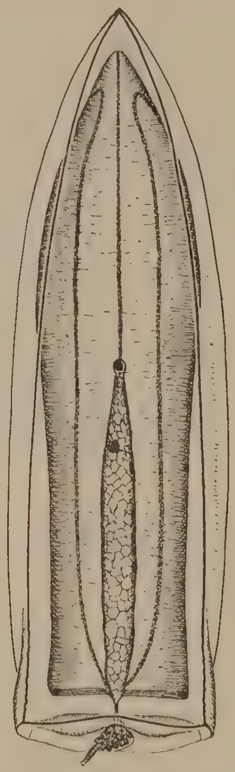
Fig. 28. *Lensia conoidea*; ventral view of specimen illustrated in Fig. 27.

Considerable variation appears in the length and the outline of the somatocyst (Fig. 30), and in the presence or absence of a definite hydroecial cavity or identation of the base (Fig. 31, 32). In the "Thor" series the somatocyst ranges in length from about 40 % of the total length of the bell to about 50 %. In Moser's figure (1925, Pl. 3, Fig. 7), it is about 33 %, in Sars's (1846, Pl. 7, Fig. 1—2) about 45 %, in Keferstein and Ehler's (1861, Pl. 5, Fig. 6) only about 25 %. Among specimens of large size from Bering Sea (Bigelow, 1913, p. 75, Fig. 2), it ranged from 23 % to slightly less than 50 % of the total length. Its maximum length may thus be set at about 50 %, it is minimum at about half as much. It varies, also, from a breadth so great as to occupy most of the space between the ventral face of the nectosac and the ventral surface of the bell, to a fusiform outline (Fig. 30). But in all cases, so far recorded, its main axis has been parallel to the main axis of the bell, or nearly so, and the stalk-portion of the somatocyst has occupied only a very minor part of the total length of that organ (Fig. 30).

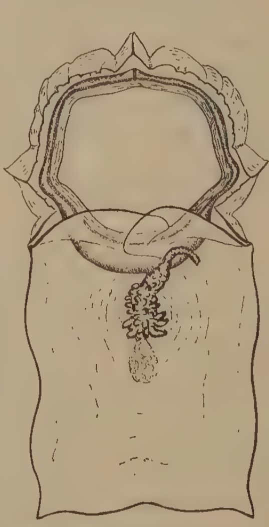
Fig. 29. *Lensia conoidea*; basal view of superior nectophore about 14 mm. long, "Thor" St. 36.

According to Moser (1925), the type of somatocyst occurring in *L. fowleri* Bigelow, in which this organ is still shorter, and with its main axis transverse to that of the nectophore, falls within the varietal range of *conoidea*, consequently she refers *fowleri* to the synonymy of the latter species. But while *conoidea* closely resembles *fowleri* in general outlines, Totton (p. 370) has already pointed out other differences. And this, as discussed on page 55, applies equally to *L. subtiloides* Lens and Van Riemsdijk, which Moser (1925) and Bigelow (1913, p. 73) also united with *conoidea*.

The range of variation in the conformation of the ventro-basal part of the superior nectophore (presence or absence of the hydroecial furrow, and the depth of the latter if present), also proves to be considerable, in preserved material. Browne (1926, p. 78) has already pointed out that the "Albatross" specimens from Bering Sea, showed a well marked hydroecium, whereas others from the Faroes and Irish waters did not. Because of this difference, he concluded that the North Pacific form was not identical with the North Atlantic. It proves, however, that both extremes are represented in each ocean. On the one hand, the base of the bell may be square-cut, without any definite indentation, and with the point of connection between the stiel-canal and the stem (well below the level of the opening of the nectosac) lying at about the level of the ventrolateral margins of the bell (Fig. 31). In specimens of this type, represented not only in the "Thor" collection[1], but also among the "Albatross" series from Bering Sea, the basal boundary of the ventral facet may either be entire, following a nearly straight line, without a definite median groove (Fig. 28), or its angular boundary may be interrupted in the median line (Fig. 31 B).

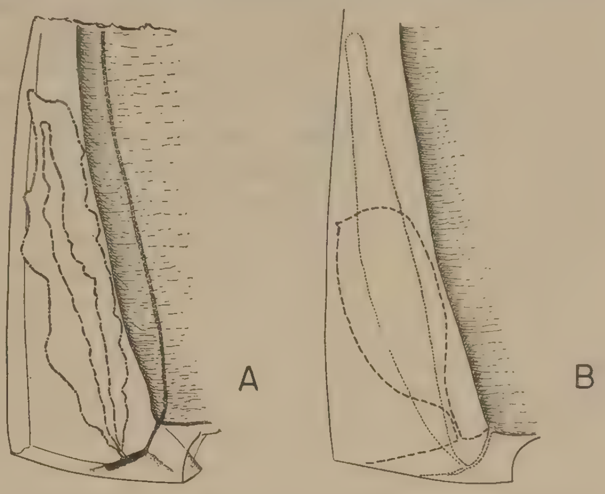

Fig. 30. *Lensia conoidea*; lateral view (diagrammatic) of ventrobasal portion of superior nectophores, to illustrate variations in the size of the somatocyst. A. Two specimens from "Thor" St. 36, each about 15 mm. long. B. Specimens 22 mm. long (with long somatocyst equal to 48% of total length) and 19 mm. (with short somatocyst equal to 26% of total length) from Bering Sea, "Albatross" St. 4759.

On the other hand, other specimens (Atlantic as well as Pacific) show a distinct hydroecial groove, varying from very shallow (the usual state, Fig. 27) to so deep that the junction of the stiel-canal with the stem lies little, if any, below the level of the opening of the nectosac (Bigelow, 1913, Textfig. 2, p. 74). The extreme case so far seen is illustrated by a specimen from Bering Sea (Fig. 32), in which the hydroecial indentation is expanded in the form of two subsidiary hollows, which rise above the level of the nectosac, enclosing the basal part of the somatocyst between them. Furthermore, the basal boundary of the ventral facet of specimens with definite hydroecial indentations is usually interrupted in the median line by a shallow,

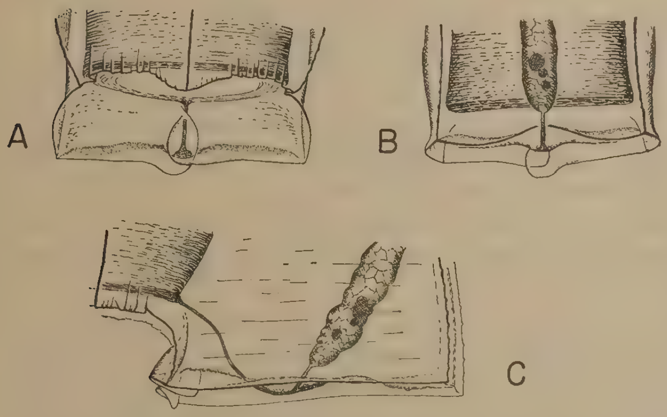

Fig. 31. *Lensia conoidea*; A. Dorsal view of basal part of superior nectophore, 14.6 mm. long; "Thor" St. 36. B. Ventral view of the same. C. Lateral view of the same.

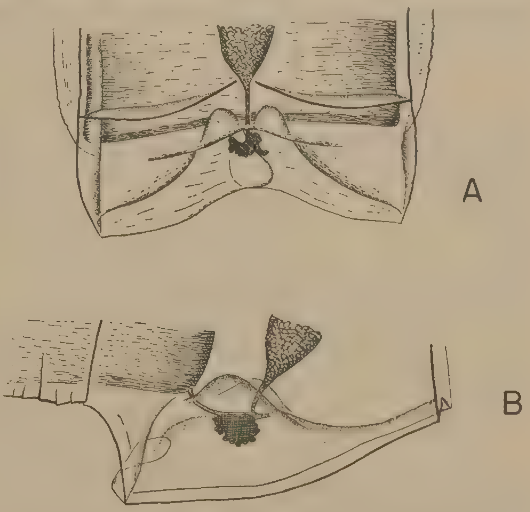

Fig. 32. *Lensia conoidea*; hydroecial portion of superior nectophore 20 mm. long, from Bering Sea, "Albatross" St. 4775. A. Ventral view. B. Lateral view.

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[1] This is the type shown by Sars (1846, Pl. 7, Fig. 1—2) and by Keferstein and Ehlers (1861, Pl. 5, Fig. 6—7).

groove-like extension, ventrad, of the hydroecium (Fig. 32 B) though occasionally it is continuous. Without examination of living material it is impossible to state how far these variations of the hydroecial region represent different states of relaxation and contraction. At any rate they are not specific, because there is no discontinuity between the extremes.

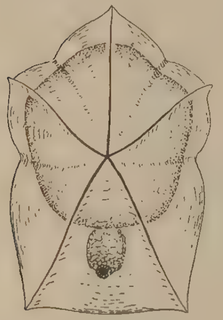

Fig. 33. *Lensia conoidea*; apical view of superior nectophore illustrated in Fig. 27.

The fact that these several variants have now been found to occur, both among the Atlantic specimens, of the *conoidea* type that we have examined, and among the North Pacific, confirms the earlier view (Bigelow, 1913) that no specific distribution can be drawn between the two.

In the preserved state, the two wings into which the dorsal face of the basal sector is split, below the level of the nectosac, show considerable variation in outline — but much of this is obviously due to contraction in the preservative. In most of the better-preserved specimens, the condition approximates that shown in Figures 29 and 31. In most cases, at least, the right wing overlaps (is dorsad to) the left wing. But one specimen showed the reverse condition. But the condition of the material prevents critical examination of this point. In most cases, the basal parts of the dorsal and ventral ridges are slightly denticulate or wavy, the remainder of their courses smooth. But there is considerable variation in the respect.

**Inferior Nectophore.** The inferior nectophore has been redescribed and figured both by Moser (1925, p. 161, Pl. 3, Fig. 8) and by Bigelow (1913, p. 75, Pl. 6, Fig. 3). But examination of the considerable series from "Thor" Station 36, and comparison with Sars's (1846, Pl. 7, Fig. 3) original illustrations, shows that neither of the two recent accounts is adequate, for while Moser's does not correctly state the outline of the ventral lamella, Bigelow's was not correct as regards the course of the apical sector of the lateral subumbral canals. The conditions exhibited by a representative from Station 36 are therefore illustrated in Fig. 34.[1]

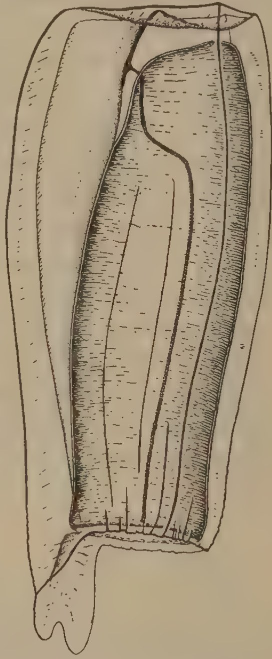

Fig. 34. *Lensia conoidea*; lateral view of inferior nectophore, 18 mm. long from "Thor" St. 36.

Unfortunately, the inferior nectophores, of the "Thor" series have all become detached from the superior bells, either in the net, or in the process of preservation. However, the facts that they were taken in the same hauls with roughly equal numbers of superior *conoidea* nectophores, and (more significant) that in all essentials they very closely resemble Sars's (1846, Pl. 7) original illustrations of inferior bells connected with the superiors, establishes their specific identity.

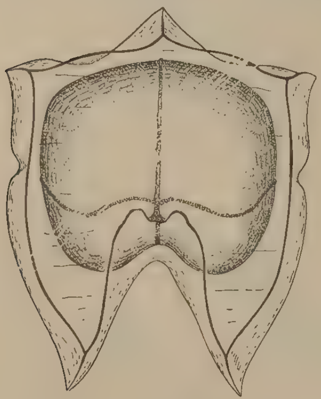

Fig. 35. *Lensia conoidea*; apical view of inferior nectophore, 5.5 mm. broad (dorso-ventrally) from Bering Sea, "Albatross" St. 4760.

As Sars observed, the squarely truncate outline of the apex is distinctive (Fig. 34, 35). The bell is pentagonal in cross section, with one well marked dorsal, two lateral, and two ventral ridges. His figure, from life, shows the dorso-lateral and ventro-lateral facets as only slightly concave. And a well expanded specimen from Bering Sea (Fig. 35), shows this same condition, which is no doubt the normal one. But it is likely that the bells can, when swimming, assume the contraction-phase shown by the "Thor" specimens from Station 36, in which the facets are deeply grooved between the ridges. With the ventral wings narrowing form the apex toward the base, the hydroecial groove (open from end to end) is much deeper apically than basally.

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[1] We are in doubt as to the meaning of Totton's (1932, p. 367) statement that the inferior nectophore of this species exhibits a "diverticulum in the nectocalyx anterior to the entry of the pedicular canal".

The present series (or such of them as are in good enough condition) show the lateral subumbral canals (Fig. 34) as following the sinuous course (first running toward the base, then swinging dorsad, to turn again toward the base near the mid-line of the nectosac) described by Sars (1846), by Keferstein and Ehlers (1861) and recently by Moser (1925, p. 161, Pl. 3, Fig. 8). The earlier illustration (Bigelow, 1913, Pl. 6, Fig. 3) of a Bering Sea specimen was erroneous in this respect.

On the other hand, the basal wing was correctly shown there as indented in the mid-line, with the right side somewhat longer than the left (Fig. 34), as, indeed, Sars long ago pictured it. We have seen no variant in this respect, other than such small differences in precise outline as naturally results from contraction, and from the distortion of preserved specimens. Moser's (1925, p. 155) statement that the basal wing is a "halbrunde Lamelle ohne Medianteilung" is not correct for this species — in fact her own illustration (Pl. 3, Fig. 8) does show a shallow indentation of the wing, in the median line.

## LENSIA FOWLERI Bigelow 1911.

Figs. 36—39, 47.

*Diphyes fowleri*, Bigelow, 1911 a, p. 346, Pl. 28, Fig. 5; 1911 b, p. 255, Pl. 8, Fig. 4, Pl. 9, Fig. 5.
For recent bibliography, see Leloup, 1934, p. 41.

### Material.

St. 3. 47°45′ N., 5°28′ W. 30. XI. 1908.
Y. 65 m w. 1 sup. nectoph.
St. 10. 37°21′ N., 16° 45′ E. 15. XII. 1908.
Y. 600 m w. 2 sup. nectoph.
St. 11. 36°57′ N., 18°16′ E. 16. XII. 1908.
Y. 300 m w. 5 sup. nectoph.
St. 12. 39°34′ N., 17°17′ E. 19. XII. 1908.
Y. 300 m w. 13 sup. nectoph.
Y. 1000 m w. 6 sup. nectoph.
St. 13. 39°43′ N. 17°30′ E. 19. XII. 1908.
Y. 1000 m w. 15 sup. nectoph.
St. 26. 40°40′ N., 13°59′ E. 18. I. 1908.
Y. 300 m w. 9 sup. nectoph.
St. 30. 41°15′ N., 11°55′ E. 21. I. 1909.
Y. 300 m w. 2 sup. nectoph.
St. 31. 41°44′ N., 10°52′ E. 21. I. 1909.
Y. 600 m w. 11 sup. nectoph.
St. 35. 43°36′ N., 7°36′ E. 28. I. 1909.
Y. 1000 m w. 4 sup. nectoph.
St. 36. 42°49′ N., 6°54′ E. 30. I. 1909.
Y. 65 m w. 1 sup. nectoph.
Y. 300 m w. 3 sup. nectoph.
St. 39. 39°41′ N., 10°02′ E. 1. II. 1909.
Y. 300 m w. 6 sup. nectoph.
St. 46. 37°17′ N., 6°00′ E. 7. II. 1909.
Y. 600 m w. 8 sup. nectoph.
St. 47. 36°55′ N., 3°12′ E. 10. II. 1909.
Y. 300 m w. 6 sup. nectoph.
St. 50. 37°02′ N., 1°17′ E. 17. II. 1909.
Y. 65 m w. 1 sup. nectoph.
Y. 300 m w. 2 sup. nectoph.
St. 51. 36°27′ N., 0°37′ W. 18. II. 1909.
Y. 300 m w. 5 sup. nectoph.
St. 57. 36°40′ N., 3°30′ W. 20. II. 1909.
Y. 200 m w. 5 sup. nectoph.
St. 58. 36°36′ N. 4°24′ W. 20. II. 1909.
Y. 100 m w. 6 sup. nectoph.
St. 59. 36°02′ N., 4°24′ W. 21. II. 1909.
Y. 100 m w. 3 sup. nectoph.
St. 65. 35°53′ N., 7°26′ W. 24. II. 1909.
Y. 600 m w. 3 sup. nectoph.
Y. 1600 m w. 1 sup. nectoph.
St. 66. 36°16′ N., 6°52′ W. 25. II. 1909.
Y. 1200 m w. 1 sup. nectoph.
St. 69. 36°13′ N., 9°44′ W. 28. II. 1909.
Y. 300 m w. 10 sup. nectoph.
St. 75. 45°37′ N., 7°03′ W. 9. III. 1909.
C. 4300 m w. 1 sup. nectoph.
St. 89. 36°28′ N., 8°22′ W. 16. VI. 1910.
Y. 1000 m w. 1 sup. nectoph.
St. 91. 35°53′ N., 7°26′ W. 18. VI. 1910.
Y. 1600 m w. 1 sup. nectoph.
St. 95. 35°57′ N., 6°00′ W. 23. VI. 1910.
Y. 300 m w. 2 sup. nectoph.
St. 96. 35°48′ N., 5°58′ W. 23. VI. 1910.
Y. 65 m w. 1 sup. nectoph.
St. 106. 36°33′ N., 2°00′ W. 25. VI. 1910.
Y. 300 m w. 1 sup. nectoph.
St. 107. 36°18′ N., 1°14′ W. 25. VI. 1910.
Y. 300 m w. 4 sup. nectoph.
St. 108. 36°03′ N., 0°27′ W. 25. VI. 1910.
Y. 65 m w. 1 sup. nectoph.
St. 112. 36°56′ N., 2°15′ E. 27. VI. 1910.
Y. 300 m w. 25 sup. nectoph.
St. 113. 36°53′ N., 3°09′ E. 28. VI. 1910.
Y. 300 m w. 6 sup. nectoph.
St. 115. 38°17′ N., 4°11′ E. 28. VI. 1910.
Y. 300 m w. 29 sup. nectoph.
Y. 2000 m w. 13 sup. nectoph.
St. 116. 39°27′ N., 5°26′ E. 29. VI. 1910.
Y. 300 m w. 14 sup. nectoph.
St. 118. 41°00′ N., 6°43′ E. 30. VI. 1910.
Y. 65 m w. 1 sup. nectoph.
Y. 300 m w. 147 sup. nectoph.
St. 120. 42°31′ N., 7°41′ E. 1. VII. 1910.
Y. 300 m w. 5 sup. nectoph.
St. 121. 43°08′ N., 8°05′ E. 2. VII. 1910.
Y. 25 m w. 1 sup. nectoph.
St. 122. 43°50′ N., 8°34′ E. 2. VII. 1910.
Y. 600 m w. 5 sup. nectoph.
Y. 1200 m w. 2 sup. nectoph.
St. 123. 44°14′ N., 8°55′ E. 3. VII. 1910.
Y. 300 m w. 1 sup. nectoph.
St. 125. 43°54′ N., 9°13′ E. 9. VII. 1910.
Y. 300 m w. 30 sup. nectoph.
St. 126. 42°43′ N., 9°50′ E. 10. VII. 1910.
Y. 300 m w. 8 sup. nectoph.
St. 129. 40°05′ N., 11°31′ E. 12. VII. 1910.
Y. 300 m w. 2 sup. nectoph.
Y. 600 m w. 2 sup. nectoph.
Y. 1000 m w. 2 sup. nectoph.
St. 131. 38°36′ N., 11°00′ E. 13. VII. 1910.
Y. 1000 m w. 2 sup. nectoph.
St. 132. 38°57′ N., 9°47′ E. 14. VII. 1910.
Y. 300 m w. 5 sup. nectoph.
Y. 600 m w. 7 sup. nectoph.

St. 133. 38°18′ N., 9°59′ E. 14. VII. 1910.
Y. 300 m w. 3 sup. nectoph.
Y. 600 m w. 13 sup. nectoph.
St. 134. 37°37′ N., 10°17′ E. 15. VII. 1910.
Y. 300 m w. 39 sup. nectoph.
St. 137. 37°17′ N., 10°56′ E. 19. VII. 1910.
Y. 250 m w. 5 sup. nectoph.
St. 138. 37°37′ N., 11°25′ E. 19. VII. 1910.
Y. 1000 m w. 10 sup. nectoph.
St. 139. 37°57′ N., 11°54′ E. 20. VII. 1910.
Y. 300 m w. 63 sup. nectoph.
Y. 800 m w. 4 sup. nectoph.
St. 143. 35°18′ N., 16°25′ E. 23. VII. 1910.
Y. 300 m w. 37 sup. nectoph.
Y. 1000 m w. 3 sup. nectoph.
St. 156. 32°16′ N., 26°03′ E. 30. VII. 1910.
Y. 600 m w. 1 sup. nectoph.
St. 160. 35°59′ N., 28°14′ E. 1. VIII. 1910.
Y. 300 m w. 2 sup. nectoph.
Y. 1000 m w. 4 sup. nectoph.
St. 163. 37°52′ N., 26°22′ E. 3. VIII. 1910.
Y. 200 m w. 65 sup. nectoph.
St. 181. 38°49′ N., 25°09′ E. 13. VIII. 1910.
Y. 300 m w. 24 sup. nectoph.
St. 182. 38°13′ N., 24°48′ E. 14. VIII. 1910.
Y. 600 m w. 26 sup. nectoph.
St. 186. 37°57′ N., 19°51′ E. 17. VIII. 1910.
Y. 300 m w. 65 sup. nectoph.
Y. 1200 m w. 17 sup. nectoph.
St. 187. 37°54′ N., 18°02′ E. 18. VIII. 1910.
Y. 300 m w. 14 sup. nectoph.
Y. 1000 m w. 3 sup. nectoph.
St. 189. 37°44′ N., 15°58′ E. 19. VIII. 1910.
Y. 300 m w. 7 sup. nectoph.
Y. 1000 m w. 9 sup. nectoph.
St. 192. 38°07′ N., 15°35′ E. 20. VIII. 1910.
Y. 300 m w. 36 sup. nectoph.
Y. 600 m w. 16 sup. nectoph.
St. 193. 38°15′ N., 15°39′ E. 21. VIII. 1910.
Y. 10 m w. 2 sup. nectoph.
St. 194. 38°33′ N., 15°29′ E. 21. VIII. 1910.
Y. 1200 m w. 11 sup. nectoph.
St. 195. 39°02′ N., 14°55′ E. 21. VIII. 1910.
Y. 300 m w. 34 sup. nectoph.
St. 197. 40°34′ N., 13°36′ E. 24. VIII. 1910.
Y. 300 m w. 12 sup. nectoph.
St. 199. 39°32′ N., 10°49′ E. 25. VIII. 1910.
Y. 300 m w. 22 sup. nectoph.
Y. 1000 m w. 11 sup. nectoph.
St. 202. 38°59′ N., 9°25′ E. 26. VIII. 1910.
Y. 300 m w. 12 sup. nectoph.
St. 204. 38°52′ N., 7°43′ E. 27. VIII. 1910.
Y. 300 m w. 127 sup. nectoph.
Y. 1000 m w. 29 sup. nectoph.
St. 206. 39°32′ N., 5°15′ E. 28. VIII. 1910.
Y. 300 m w. 21 sup. nectoph.
Y. 1000 m w. 3 sup. nectoph.
Y. 2000 m w. 5 sup. nectoph.
St. 217. 38°01′ N., 1°48′ E. 1. IX. 1910
Y. 300 m w. 14 sup. nectoph.
St. 222. 35°53′ N., 0°57′ W. 4. IX. 1910.
Y. 300 m w. 4 sup. nectoph.
St. 223. 36°13′ N., 1°28′ W. 5. IX. 1910.
Y. 300 m w. 8 sup. nectoph.
St. 232. 36°28′ N., 9°06′ W. 9. IX. 1910.
Y. 300 m w. 17 sup. nectoph.

This species, orginally described from the Bay of Biscay, and soon after from the Eastern Tropical Pacific, was relegated by Moser (1925, p. 154) to the synonymy of *L. conoidea*[1] (see p. 50).

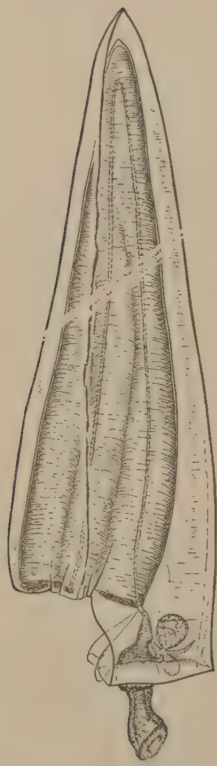

Fig. 36. *Lensia fowleri;* lateral view of superior nectophore, about 4 mm. high, collected by H. M. S. "Research" in the Bay of Biscay (Mus. Comp. Zool. Cat. No. 775).

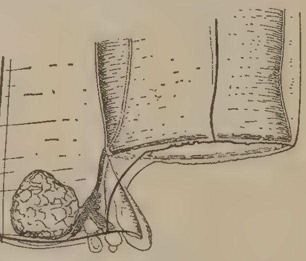

Fig. 37. *Lensia fowleri;* lateral view of basal portion of superior nectophore about 7.6 mm. high, collected by H. M. S. "Research" in the Bay of Biscay (Mus. Comp. Zool. Cat. No. 775).

But Browne (1926) and Totton (1932) have recently argued that *fowleri* is in fact a distinct species. And reexamination of specimens from the original series of *fowleri*, now in the collection of the Museum of Comparative Zoölogy confirms this view. The most striking difference between it and *conoidea* (which it closely resembles in general conformation) is in the shape of the somatocyst. This, in *fowleri*, is roughly spherical and lies largely, if not wholly, below the level of the opening of the nectosac (Figs. 36—39). And it is so closely connected with the basal plate that there is no distinguishable stalk. In *conoidea*, on the other hand, the somatocyst is more or less fusiform, reaching well above the opening of the nectosac even in the specimens in which it is shortest (p. 51, Fig. 30), and usually, if not invariably it has a distinguishable stalk. Moser (1925, p. 156), it is true, thought it impossible to separate the species by the somatocyst, on the ground that in some specimens she examined, its outline could not be classified either as "richtig blasig" or as "eigentlich cylindrisch". Her union of

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[1] In the latter Moser used Sars's name *truncata*.

*fowleri*[1] with *conoidea* seems also to have been influenced by the fact that the two were taken at the same stations. But as just remarked, the difference in the form of the somatocyst lies not only in its precise outline, i. e. whether spherical, egg-shaped, or narrow-fusiform, but still more in its situation. And comparison of a very young *fowleri* (Fig. 36), with a *conoidea* only slightly larger, shows that this difference obtains from an early stage in growth.

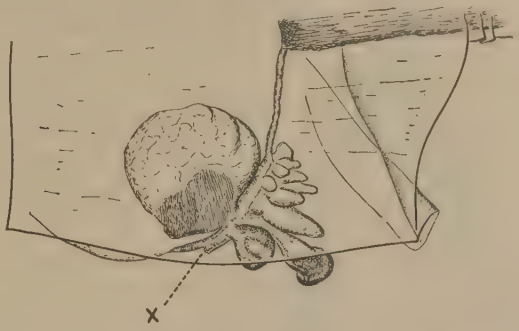

Fig. 38. *Lensia fowleri*; basal portion of large superior nectophore showing reserve bud, collected by H. M. S. "Research" in the Bay of Biscay (Mus. Comp. Cat. No. 775).

Furthermore, Totton (1932) has pointed out that the form of the somatocyst is not the only specific difference between *fowleri* and *conoidea*, but that the two can also be distinguished by the fact that in *fowleri* the marginal outline, opposite the dorsal ridge, does not project beyond the general level of the bell opening (Figs. 37, 39, 47), whereas in *conoidea* it does so project (Fig. 27, 47). And though this difference is minor, we have found it invariable within the considerable series of the two species that we have recently studied. Totton (1932, p. 370) has likewise noted that the lateral ridges "at their oral ends slope back in a characteristic way towards the mouth plate". The distance from the oral margin to the base of the bell is also usually (if not always) greater in *fowleri* than in *conoidea*. On the other hand another character, noted by Totton as distinctive, namely the proximity of the apex of the nectosac to the apex of the bell — is not reliable. In some specimens of *conoidea* (Fig. 27) the former is as close to the latter as in some examples at least of *fowleri*.

Although *fowleri* has now been reported from several collections, and from widely separated localities, its inferior nectophore either remains undescribed, or if it has been seen, it has been confused with that of some other species. In fact the only previous evidence that the species is bipartite, not unipartite (as are all known species of *Muggiaea*) was that, in the original series (Bigelow, 1911 a, p. 347), some of the superiors still showed "remnants of what was apparently the pedicular canal" at the base of the stem, and that Browne (1926, p. 75) saw specimens with minute buds, apparently the forerunners of inferior nectophores. One small specimen (4 mm., Fig. 36) in the "Research" series, (not mentioned in the original account) so young that only one large siphon had yet developed, shows what appears to be the bud for the future inferior nectophore, as does another larger one (Fig. 38); and also what is apparently the point of attachment of an inferior bell, now detached (marked X in the illustration). Available evidence thus indicates that reference of this species to *Lensia* is probably correct.

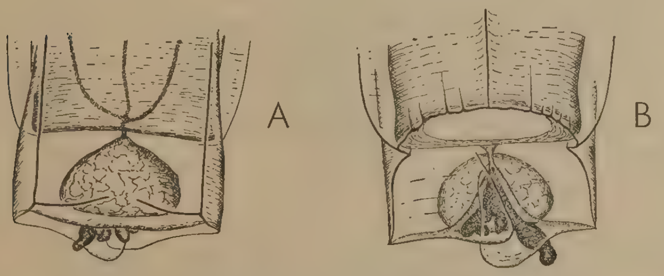

Fig. 39. *Lensia fowleri*; basal portion of superior nectophore, specimen shown in Fig. 37. A. Ventral view. B. Dorsal view.

## LENSIA MULTICRISTATA Moser 1925.

Figs. 40—44, 47.

*Galeolaria multicristata*, Moser, 1925, p. 165, Pl. 3, Fig. 9.
*Diphyes bigelowi*, Browne, 1926, p. 77.
*Muggiaea kochii*, (Partim) Bigelow, 1911 a, p. 340, 1911 b, p. 188, Pl. 12, Fig. 2—4.
*Lensia multicristata*, Totton, 1932, p. 364; Leloup, 1934, p. 33, Fig. 8.

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[1] Also *subtiloides*.

? *Lensia multicristata*, forme *grimaldii*, Leloup, 1934, p. 36, Fig. 9, 10.
? *Lensia grimaldii*, Leloup, 1933, p. 37, Pl. 1, Fig. 1—10.
Non *D. kochii*, Will, 1844, p. 77, Pl. 2, Fig. 22.
Non *M. kochii*, Chun, 1882, p. 679, Pl. 16, Fig. 2.

### Material.

St. 10. 37°21′ N., 16°45′ E. 15. XII. 1908.
Y. 600 m w. 41 sup. nectoph.
St. 13. 39°43′ N., 17°30′ E. 19. XII. 1908.
Y. 1000 m w. 13 sup. nectoph.
St. 35. 43°36′ N., 7°36′ E. 29. I. 1909.
Y. 1600 m w. 3 + sup. nectoph.
St. 46. 37°17′ N., 6° 00′ E. 7. II. 1909.
Y. 1600 m w. 6 sup. nectoph.
St. 47. 36°55′ N., 3°12′ E. 10. II. 1909.
Y. 300 m w. 1 sup. nectoph.
St. 50. 37°02′ N., 1°17′ E. 17. II. 1909.
Y. 600 m w. 4 sup. nectoph.
St. 51. 36°27′ N., 0°37′ W. 18. II. 1909.
Y. 300 m w. 50 sup. nectoph.
St. 65. 35°53′ N., 7°26′ W. 24. II. 1909.
Y. 600 m w. 17 sup. nectoph.
Y. 600 m w. 5 sup. nectoph.
St. 66. 36°16′N., 6°52′ W. 25. II. 1909.
Y. 1200 m w. 1 sup. nectoph.
St. 68. 36°39′ N., 7°21′ W. 27. II. 1909.
Y. 800 m w. 4 sup. nectoph.
St. 69. 36°13′ N., 9°44′ W. 28. II. 1909.
Y. 600 m w. 61 + sup. nectoph.
St. 71. 39°35′ N., 9°45′ W. 4. III. 1909.
Y. 1600 m w. 4 sup. nectoph.
St. 74. 44°21′ N., 7°55′ W. 9. III. 1909.
Y. 600 m w. 1 sup. nectoph.
St. 75. 45°37′ N., 7°03′ W. 9. III. 1909.
C. 4300 m w. 1 + sup. nectoph.
St. 80. 46°17′ N., 7°31′ W. 13. VI. 1910.
Y. 300 m w. 1 + sup. nectoph.
St. 87. 37°03′ N. 9°15′ W. 17. VI. 1910.
Y. 300 m w. 8 sup. nectoph.
St. 89. 36°28′ N., 8°22′ W. 18. VI. 1910.
Y. 300 m w. 1 sup. nectoph.
Y. 1000 m w. 7 sup. nectoph.
St. 91. 35°53′ N., 7°26′ W. 18. VI. 1910.
Y. 1600 m w. 12 sup. nectoph.
St. 95. 35°57′ N., 6°00′ W. 23. VI. 1910.
Y. 300 m w. 8 sup. nectoph.
St. 107. 36°18′ N., 1°14′ W. 25. VI. 1910.
Y. 300 m w. 70 sup. nectoph.
Y. 2000 m w. 4 sup. nectoph.
St. 108. 36°03′ N., 0°27′ W. 25. VI. 1910.
Y. 300 m w. 1 sup. nectoph.
St. 112. 36°56′ N., 2°15′ E. 27. VI. 1910.
Y. 300 m w. 146 sup. nectoph.
St. 113. 36°53′ N., 3°09′ E. 28. VI. 1910.
Y. 300 m w. 7 sup. nectoph.
St. 115. 38°17′ N., 4°11′ E. 28. VI. 1910.
Y. 300 m w. 3 sup. nectoph.
Y. 2000 m w. 11 sup. nectoph.
St. 118. 41°00′ N., 6°43′ E. 30. VI. 1910.
Y. 300 m w. 11 sup. nectoph.
St. 120. 42°31′ N., 7°41′ E. 1. VII. 1910.
Y. 300 m w. 1 sup. nectoph.
St. 122. 43°50′ N., 8°34′ E. 2. VII. 1910.
Y. 600 m w. 56 sup. nectoph.
St. 123. 44°14′ N., 8°55′ E. 3. VII. 1910.
Y. 300 m w. 2 sup. nectoph.
St. 129. 40°05′ N., 11°31′ E. 12. VII. 1910.
Y. 600 m w. 69 sup. nectoph.
Y. 1000 m w. 25 sup. nectoph.
St. 132. 38°57′ N., 9°47′ E. 14. VII. 1910.
Y. 600 m w. 24 sup. nectoph.
St. 133. 38°18′ N., 9°59′ E. 14. VII. 1910.
Y. 25 m w. 1 sup. nectoph.
Y. 300 m w. 1 sup. nectoph.
Y. 600 m w. 229 sup. nectoph.
St. 134. 37°37′ N., 10°17′ E. 15. VII. 1910.
Y. 25 m w. 1 sup. nectoph.
St. 137. 37°17′ N., 10°56′ E. 19. VII. 1910.
Y. 250 m w. 67 sup. nectoph.
St. 138. 37°37′ N., 11°25′ E. 19. VII. 1910.
Y. 1000 m w. 70 sup. nectoph.
St. 139. 37°57′ N., 11°54′ E. 20. VII. 1910.
Y. 800 m w. 7 sup. nectoph.
St. 143. 35°18′ N., 16°25′ E. 24. VII. 1910.
Y. 1000 m w. 1 sup. nectoph.
St. 144. 34°31′ N., 18°40′ E. 24. VII. 1910.
Y. 2000 m w. 1 sup. nectoph.
St. 147. 31°35′ N., 19°02′ E. 25. VII. 1910.
Y. 1000 m w. 7 sup. nectoph.
St. 160. 35°59′ N., 28°14′ E. 1. VIII. 1910.
Y. 1000 m w. 53 sup. nectoph.
St. 186. 37°57′ N., 19°51′ E. 17. VIII. 1910.
Y. 1200 m w. 20 sup. nectoph.
St. 199. 39°32′ N., 10°49′ E. 25. VIII. 1910.
Y. 1000 m w. 38 sup. nectoph.
St. 204. 38°52′ N., 7°43′ E. 27. VIII. 1910.
Y. 300 m w. 6 sup. nectoph.
Y. 1000 m w. 154 sup. nectoph.
St. 206. 39°32′ N., 5°15′ E. 28. VIII. 1910.
Y. 1000 m w. 56 sup. nectoph.
Y. 2000 m w. 21 sup. nectoph.
St. 217. 38°01′ N., 1°48′ E. 1. IX. 1910.
Y. 300 m w. 143 sup. nectoph.
St. 222. 35°53′ N., 0°57′ W. 4. IX. 1910.
Y. 300 m w. 59 sup. nectoph.
St. 223. 36°13′ N., 1°28′ W. 5. IX. 1910.
Y. 300 m w. 70 sup. nectoph.
St. 228. 36°02′ N., 5°06′ W. 7. IX. 1910.
Y. 300 m w. 1 sup. nectoph.
St. 231. 35°56′ N. 7°16′ W. 9. IX. 1910.
Y. 25 m w. 1 sup. nectoph.
St. 232. 36°28′ N., 9°06′ W. 9. IX. 1910.
Y. 300 m w. 1 sup. nectoph.
Y. 1000 m w. 36 sup. nectoph.
St. 234. 38°10′ N., 9°20′ W. 10. IX. 1910.
Y. 1000 m w. 3 superior nectoph.
St. 242. 46°19′ N., 6°48′ W. 16. IX. 1910.
C. 4350 m w. 7 sup. nectoph.

### Identification doubtful:—

St. 210. 41°10′ N., 2°23′ E. 30. VIII. 1910.
Y. 600 m w. 4 sup. nectoph.

In 1925, Moser (1925, p. 165) christened, as *Galeolaria multicristata*, a small diphyid, the superior nectophore of which was characterized by the presence of 7 ridges: a year later Browne (1926, p. 77) described as *Diphyes bigelowi*, a form agreeing with Moser's account, not only in this most striking feature, but in other less outstanding respects as well.

**Browne**, at the same time pointed out that examination, by him, of specimens from the Bay of Biscay described by **Bigelow** (1911 a, p. 340) as *Muggiaea kochii*, proved they belonged to the new multicristate species, having 7 ridges, not 5 as stated. And reexamination of one of the three specimens[1] has shown that this applies equally to specimens recorded as "*M. kochii*" fromthe Eastern Tropical Pacific, (**Bigelow**, 1911 b, p. 188, Pl. 12, Fig. 2) for these also have two more ridges than are shown in the illustration.

Specimens of this species of *Lensia*, if in good condition, are easily recognized by the number of ridges, a feature easily seen in apical view but which may be overlooked in side view because of the glassy transparency of most preserved specimens.

**Leloup** (1933, 1934) has recently described superior nectophores, otherwise similar, but with still more numerous (10—31) ridges. For the first such example (10 ridges) he (1933, p. 37) founded a new species *grimaldii*. But, from his study of the more extensive series collected by the "Meteor"[2], he has grouped them all, as a variety, "forme *grimaldii*", of *L. multicristata*, calling the 7-ridged variety "forme *typica*" (**Leloup**, 1934, p. 33).

Among the "Thor" collection, all of the superior *multicristata* nectophores that are in good enough condition to show this feature distinctly, have 7 ridges only. Consequently we can add nothing to **Leloup**'s discussion of the status of specimens that have a greater number.

Aside from the number of ridges in the superior nectophore, distinctive features in the exumbral sculpture pointed out by **Browne** (1926) are that, on specimens with 7 ridges, only the two ventral ridges, the two laterals, and the dorsal originate at the apex, the supplementary pair (between the ventrals and the laterals) originating at a slightly lower level (Fig. 40, 42). Furthermore, the dorsal and the two ventral ridges alone extend to the basal margin of the bell; the laterals terminate slightly above the margin, the supplemental pair of ridges still higher, in the relative positions shown in Figure 40. Neither is there any trace of marginal teeth opposite any of the ridges. None of the ridges, in any specimen examined, were definitely denticulate, but all were more or less wavy, as illustrated (Fig. 40).

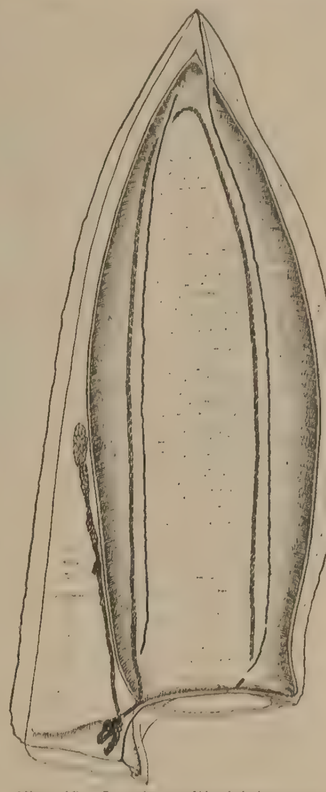

Fig. 40. *Lensia multicristata*; superior nectophore, 11 mm. high, "Thor" St. 217.

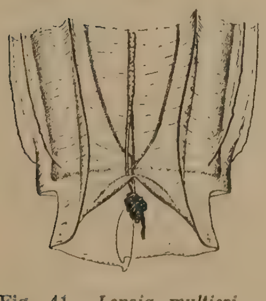

Fig. 41. *Lensia multicristata*; ventral view of basal portion of superior nectophore illustrated in Fig. 40.

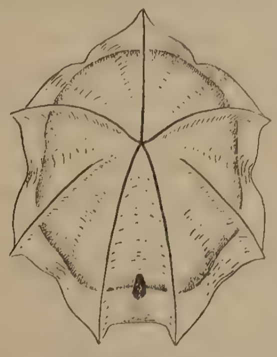

Fig. 42. *Lensia multicristata*; apical view of another superior nectophore, also about 11 mm. long, from "Thor" St. 217.

In all specimens so far described, whether by **Browne**, by **Leloup**, or by **Moser**, or in those examined by us, there is a distinct hydroecial cavity, lying however, entirely below the level of the opening of the nectosac. And the fact that the ventral facet is not only deeply grooved, basally, as described by **Browne**, but that its basal margin is rounded (Fig. 41; see also **Leloup**, 1934, Fig. 9 A) separates this species at a glance, from *L. conoidea*, and from *L. fowleri*, when seen in ventral view. As in other Lensias, the mouth plate is divided longitudinally: and as every specimen we have examined (including one from the Eastern Tropical Pacific) has borne a small rounded lobe (already mentioned by **Moser**) at the inner basal angle of each of these 2 wings, this may be taken as a specific character even if a minor one.

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[1] Only one of the 3 specimens (U. S. Nat. Mus. no. 28610) is still in good enough condition to show the feature in question.

[2] Eleven specimens, distributed as follows: one each with 16, 17, 18, 22, 28, 30 and 31 ridges; two each, with 23 and 24 ridges.

Browne has already pointed out that the somatocyst shows considerable variation, being either thick and sausage-shaped on a short stalk, or long and slender, on a long thread-like stalk. In most of the better preserved examples in the "Thor" series (represented by St. 217), the outlines of this organ vary between the extremes shown in Figure 43, i. e. it may be described as slim, fusiform, or linear, usually with a more or less definitely defined and thread-like stalk — never, however, with a definite spherical terminal dilation such as characterizes *Lensia subtilis* (p. 47). In other specimens, less well preserved, it is variously distorted, contracted or even dilated. In most specimens its length equals about 40—45 % of the length of the nectophore, from bell-opening to apex. Leloup (1934, p. 34, p. 35) has pointed out that the "système gastro-vasculaire est simple; les canaux latéraux remontent presque jusqu'au sommet de la subombrelle".

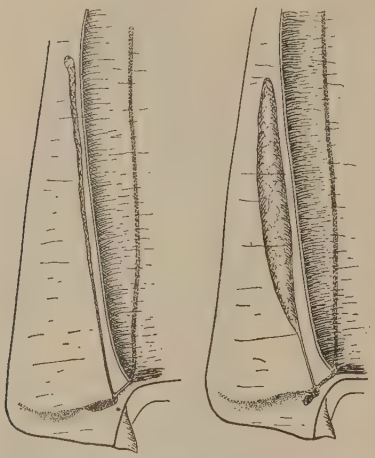

Fig. 43. *Lensia multicristata*; lateral view of basal parts of two superior nectophores, both about 12 mm. long, "Thor" St. 217, to show variations in the shape of the somatocyst.

Leloup (1934, p. 34, Fig. 8, B—D) describes and figures as belonging to this species, a single inferior nectophore, from the "Meteor" collection[1]. And the "Thor" series from Station 217 contains (among the 143 superior bells) a single inferior which agrees closely with his figures, in general outline, in conformation of the apical portion, in the long open hydroecial furrow, in simplicity of canals, in shortness of the basal wing, and in the fact that the latter is simple, not divided. Unfortunately the "Thor" specimen is not in good enough condition to show the dorsal ridge ("ventral" according to Leloup's nomenclature) the course of which is diagnostic, according to Leloup; nor whether it, like Leloup's specimen, bore a small subsidiary lappet on the hydroecial wing, near the apex. Several of the superior bells also bear large buds, near the base of the stem (Fig. 44): evidently the forerunners of future inferior bells. All but the base of the stem, has, however, been broken off in all cases, consequently the cormidia remain unknown.

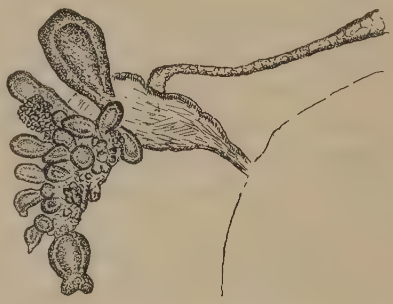

Fig. 44. *Lensia multicristata*; basal portion of stem of superior nectophore bearing a bud for inferior nectophore; "Thor" St. 69, × 62.5.

## LENSIA SUBTILOIDES Lens & Van Riemsdijk 1908.

Figs. 45, 46, 47.

*Diphyes subtiloides*, Lens and Van Riemsdijk, 1908, p. 46, Pl. 7, Figs. 59, 60, 61; Browne, 1926, p. 76.
*Lensia subtiloides*, Totton 1932, p. 364, Figs. 31, 32, 33.

### Material.

St. 80. 46°17′ N., 7°31′ W. 13. VI. 1910.
Y. 300 m w. 1 sup. nectophore.

Moser (1925) considered *L. subtiloides* a synonym of *L. conoidea*, as Bigelow (1913) had, previously. But Browne (1926) and Totton (1932) have subsequently shown that it is acually an easily distinguishable species, separated from *conoidea* both by the outline of base and hydroecium, and by the shape of the somatocyst.

[1] Whether or not this bell was still attached to a superior, i. e. whether its specific identity was certain, is not stated.

According to Browne (1926), the superior nectophore has no well-marked longitudinal ridges (his specimens were wrinkled by contraction). But Totton's (1932, Fig. 31, 32) figures of the superior nectophore clearly show lateral ridges, while also suggesting a dorsal, and the usual pair of ventrals. The one specimen in the "Thor" collection, and two others from the "Dana" expedition, are distinctly pentagonal in cross section as seen in apical view (Fig. 46). But the angles separating the facets are much less prominent than in *L. conoidea*, in *L. fowleri*, or in *L. multicristata*, and it is only along the lower two-thirds of their courses that they are acute enough to be named ridges (Fig. 46). Closer to the apex they are more rounded. But as all of these specimens show more or less damage, by capture and preservation, it is a question whether this weakening of the ridge-like character of the angles toward the apex is a normal feature of the species. Basally, the dorsal and lateral ridges extend to the margin of the bell; but there is no marginal projection opposite either of them (Fig. 45).

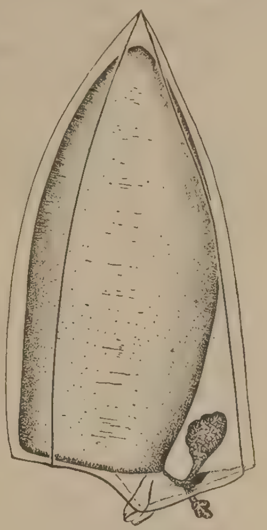

Fig. 45. *Lensia subtiloides*; lateral view of superior nectophore, 6 mm. long, from "Thor" St. 80.

Apart from this question of ridges, the most distinctive character of *L. subtiloides*, among those species of *Lensia* which it most resembles, is the obtuseness of the angle, formed by the intersection of the lateral-basal margin of the hydroecial region with the ascending marginal sector which leads to the bell opening (Fig. 45, 47).

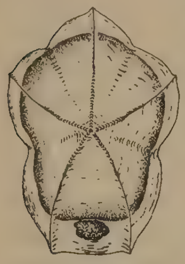

Fig. 46. *Lensia subtiloides*; apical view of superior nectophore, illustrated in Fig. 45.

In *L. conoidea* this angle is at most not more than 110°. In *multicristata* and *fowleri* it is slightly more than 90°. But in *subtiloides* the angle is about 120°. Furthermore, the hydroecial sector of the latero-basal margin, which is roughly transverse to the general longitudinal axis of the nectophore in *fowleri* and slightly oblique in *multicristata* and *conoidea*, is much more strongly oblique in *subtiloides*. In *subtiloides*, as in *fowleri* and *conoidea*, the ventro-basal corners of the bell are bluntly angular while in *multicristata* they are rounded. The outline of the very shallow — but always existant — hydroecial indentation is also distinctive, as is the fact that the two wings into which the mouth plate is divided are about in equal size, and hang well below the marginal angle.

As Totton (1932) has pointed out, the summit of the hydroecium lies at the same level as the mouth of the nectosac. In the very large series from the Great Barrier reef, Totton (1932, p. 365) describes the distance from the base of the somatocyst to the mouth plate as about half that between the base of the somatocyst and ventral wall. In one "Dana" example the apical end of the somatocyst lies close to the ventral wall as he described, farther from the ventral wall in another, and in the "Thor" specimen. Poor preservation may be responsible for these differences. In the present example, the form of the somatocyst lies well within the range of variation illustrated by Totton (1932, Fig. 31b).

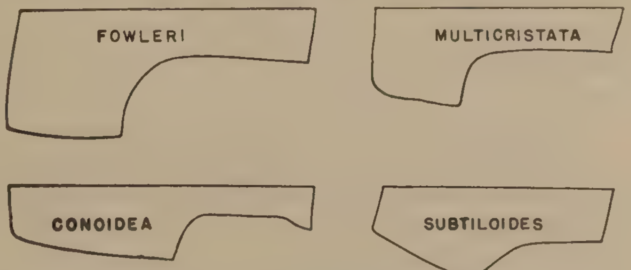

Fig. 47. Outlines of the basal portion of the superior nectophore of 4 species of *Lensia* to show differences in shape.

Lens & Van Riemsdijk (1908), in their original description of the species, detected the bud for a future inferior bell in one specimen. Subsequently, Browne (1926) found two loose inferior bells presumably of this parentage, and Totton (1932, Fig. 32 B) has recently given a good illustration of the inferior nectophore.

## CHUNIPHYINAE Moser 1925.

## CHUNIPHYES Lens and Van Riemsdijk 1908.

### CHUNIPHYES MULTICRISTATA Lens and Van Riemsdijk, 1908.

Fig. 48.

*Chuniphyes multidentata*, Lens & Van Riemsdijk, 1908, p. 13, Pl. 1, Figs. 9—11, Pl. 2, Figs. 12—15; Bigelow, 1911 a, p. 348; 1911 b, p. 262, Pl. 8, Fig. 9, Pl. 10, Fig. 7, Pl. 12, Fig. 6; 1918, p. 425; 1919, p. 344; 1931, p. 566; Moser, 1925, p. 357, Pl. 23, Figs. 1—4, Pl. 24, Figs. 1, 2; Leloup, 1932, p. 26; 1933, p. 39; 1934, p. 44.

Material.

St. 65. 35°53′ N., 7°26′ W. 24. II. 1909.
  Y. 1600 m w. 5 sup. nectoph.; 4 inf. nectoph.
St. 66. 36°16′ N., 6°52′ W. 25. II. 1909.
  Y. 1200 m w. 13 sup. nectoph.; 17 inf. nectoph.
St. 69. 36°13′ N., 9°44′ W. 28. II. 1909.
  Y. 3000 m w. 15 nectoph. (poorly preserved).
St. 71. 39°35′ N., 9°45′ W. 4. III. 1909.
  Y. 300 m w. 11 sup. nectoph.; 10 inf. nectoph.
  Y. 600 m w. 109 sup. nectoph.; 120 inf. nectoph.
  Y. 1600 m w. 10 sup. nectoph.; 16 inf. nectoph.
St. 74. 44°21′ N., 7°55′ W. 8. III. 1909.
  Y. 600 m w. 53 sup. nectoph.; 51 inf. nectoph.
St. 75. 45°37′ N., 7°03′ W. 9. III. 1909.
  C. 4300 m w. 47 sup. nectoph.; 48 inf. nectoph.
St. 76. 47°01′ N., 5°48′ W. 10. III. 1909.
  Y. 25 m w. 1 sup. nectoph.
  Y. 1600 m w. 94 sup. nectoph.; 87 inf. nectoph.

The general organization of the nectophores (both inferior and superior) of this interesting bathypelagic diphyid is now well known, from the specimens brought in by the "Research" (Bigelow, 1911 a), "Albatross" (Bigelow, 1911 b), "Gauss" (Moser, 1925) and "Arcturus" (Bigelow, 1931).

But although a considerable number of examples have been examined, all of them have been more or less distorted or injured in one way or another, either by contraction in preservation, or by pressure in the net. Consequently, none of the illustrations so far published can claim to show the outlines of the living animal in its normal state. For this reason, it is not yet possible to state to what degree the differences that have been described (and that can be seen in any large series) in the relative prominence of the teeth or angles at the basal extremities of the ridges of the superior nectophore, and in the degree of concavity of the several facets, represent individual variations, how far they represent temporary states, from one to another of which the bell may pass in its normal contractions and expansions, or how far they result from the effects of the preservative.

The present series adds still another type of variation (evidently artifactual), for the ridges of different bells (both superior and inferior) vary in their degree of prominence, from angles slightly more acute than 90°, to definitely fin-like or blade-like expansions, in which case they are notably tough and stiff. The condition earlier illustrated for one of the Pacific specimens (Bigelow, 1931, Fig. 209) stands midway between these extremes, as do most of the specimens so far examined.

Differences in interpretation between Moser's and earlier accounts of the morphology of the basal-hydroecial region in the superior nectophore, are discussed elsewhere (Bigelow, 1931, p. 566).

No purpose would be served by additional illustrations of the superior nectophore until living examples are studied. But comparison between the considerable "Thor" series and other examples in the collection of the Museum of Comparative Zoölogy, makes it possible to add some detail to earlier accounts of the inferior nectophore. This, as previously described, has three ridges at the apex, one dorsal and two ventro-lateral, each of which divides dichotomously so that there are six ridges over most of the length of the bell, and six basal teeth (Fig. 48). In all the specimens examined, the dorsal ridge divides about 8 $^{0}/_{0}$ of the distance from apex to base, and the two resultant ridges enclose between them a narrow triangular facet. Each ventro-lateral ridge divides at about 25 $^{0}/_{0}$ of the distance apex to base, the lateral member of each pair continuing directly to the base, but the ventral member bending at first abruptly ventrad, then abruptly toward the base. This gives to the hydroecial wing on its respective side, a characteristic outline shown more easily in the illustration (Fig. 48) than verbally, and a corresponding form to the hydroecial groove. The two ventro-basal teeth are asymmetrical, the right hand (left, according to Totton's and Moser's terminology, see p. 4) much the larger, as previously described. The other teeth are symmetrical. A minor feature, not previously remarked, is that the lateral tooth, on each side, originates some distance above the margin of the nectophore. The two dorsal teeth are smaller than the laterals — but in all the specimens examined they project far enough to deserve to be so named. According to Moser (1925, p. 360), inferior nectophores, when full-grown, entirely lack denticulation. In this respect, however, inferior bells vary as do superiors (Bigelow, 1931, p. 569): all that we have examined have shown more or less denticulation of the basal region, in some cases confined chiefly to the teeth and basal margin (Fig. 48), on others extending well up the ridges as well.

Discovery, among the "Thor" series, of one inferior nectophore still attached to the basal part of the stem, with a fragment of the pedicular attachment by which the latter was originally connected to the superior nectophore, allows confirmation of the earlier account (Bigelow, 1911 b) of the union of the two bells. In the case of the inferior, the point of attachment (marked by a projection of the gelatinous substance axially into the hydroecium), lies about one third of the distance between the apex and the level of the apex of the nectosac (Fig. 48) as earlier described (Bigelow, 1911 b, Pl. 8, Fig. 9, Pl. 10, Fig. 7), while the canal, joining the nectosac, is situated a short distance below the apex of the latter. According to Moser (1925, Pl. 24, Fig. 1), however, the point of pedicular attachment in a young bell was opposite the origin of the stiel canal. It would be interesting to trace the transition from this juvenile condition to the adult.

In all the "Thor" specimens, the gelatinous wall separating hydroecium from nectosac is much thinner than in the only specimen yet seen in which the two bells were still connected (cf. Fig. 48 with Bigelow, 1911 b, Pl. 8, Fig. 9).

Moser (1925) has already pointed out that the extensions of the somatocyst-system from the point of attachment of the inferior nectophore, to the apex of the bell in the one direction, and basally, along the face of the hydroecium, from the point of origin of the stiel-canal in the other, correspond to the somatocyst-system of the superior nectophore. Unfortunately, none of the specimens we have seen have shown the termination of the descending branch of the somatocyst, nor has it been possible to follow the subumbral canals throughout their entire course. So far as can be seen, however, they are of the usual diphyid type.

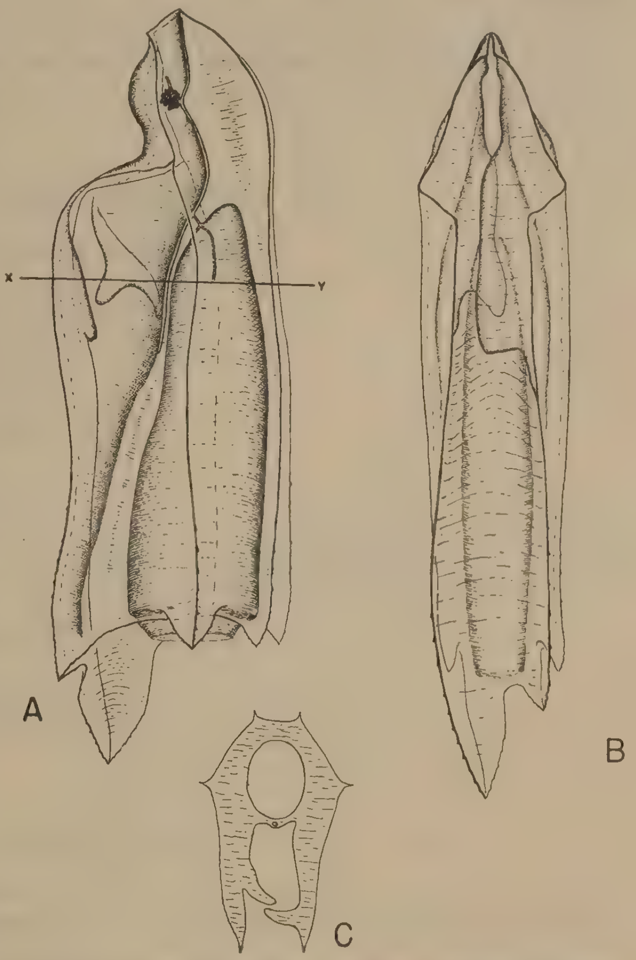

Fig. 48. *Chuniphyes multidentata*; composite drawings of inferior nectophore based chiefly on Bay of Biscay specimens about 30 mm. long, collected by H. M. S. "Research" (Mus. Comp. Zool. Cat. No. 801). A. Lateral view. B. Ventral view. C. Cross section at level XY.

Earlier accounts have mentioned the re-entrant and overlapping flaps borne by the hydroecial wings opposite the apical part of the nectosac, which give to the open groove the potential character of a closed tube. In most of the examples examined, the longitudinal extent of these flaps, and their outlines, have been about as shown in Figure 48. In all that we have examined, the left-hand flap has been the longer, but Moser (1925, Pl. 23, Fig. 4) illustrates an example showing the reverse relationship. Usually, too, the left-hand encloses the right-hand. But as the opposite was the case not only in Moser's figured example, but also in one from the Eastern Pacific Expedition (Bigelow, 1911 b, Pl. 10, Fig. 7), no rule can be laid down — indeed a given specimen might well bring first the one, and then the other flap outside, in its normal contractions and expansions.

All but the basal end of the stem, with young buds for future appendages, has been lost from every specimen yet seen. Consequently the developed appendages remain unknown.

# PHYSOPHORAE Eschscholtz 1829.

## FORSKALIIDAE Haeckel 1888.

### FORSKALIA Kölliker 1853.

### **FORSKALIA** sp.?

Material.

St. 11. 36°57′ N., 18°16′ E. 16. XII. 1908.
Y. 300 m w. Fragments of 1 col.

While this specimen is strongly contracted and in extremely fragmentary condition, the fact that the two much flattened nectophores that are still attached, still show very long pedicular canals and corresponding narrow triangular extensions of the gelatinous substance, and that one bract (still attached) is also long and narrow, suggests that this is a *Forskalia*.

### ? **FORSKALIA**

Material.

St. 89. 36°28′ N., 8°22′ W. 18. VI. 1910.
Y. 1000 m w. 1 denuded stem.

## AGALMIDAE Brandt 1835.

### AGALMA Eschscholtz 1825.

### **AGALMA** sp.?

Material.

St. 184. 38°10′ N., 22°33′ E. 17. VIII. 1910.
Y. 1000 m w. Fragments.

The material consists of fragments of stem, denuded except for the pneumatophore and one gonodendron, and one loose siphon with part of its tentacle, the latter bearing a few tentilla, the oldest of which are far enough advanced to show that they are of the tricornuate type characteristic of *Agalma*.

## AGALMIDAE genus?

Material.

Fragments at Stas. 11, 28, 29, 31, 34, 35, 36, 39, 40, 58, 66, 69, 74, 76, 80, 85, 86, 87, 89, 91, 95, 98, 106, 107, 108, 112, 116, 118, 122, 123, 125, 129, 130, 132, 133, 138, 139, 144, 145, 152, 156, 184, 186, 193, 194, 195, 196, 199, 206, 208, 209, 215, 216, 220, 223, 225, 231, 232, 233, 245, 297, 298, 339, 341.

None of these agalmid fragments are in good enough condition for positive identification, even as to the genus. The stems are either entirely denuded (except for the pneumatophore which is intact in most cases), or with parts of tentacles still attached. But none of the latter bear tentilla old enough to show the adult character, whether unicornuate (*Stephanomia*), tricornuate (*Agalma*), or polycornuate (*Lynchnagalma*). And while some of the loose nectophores are still in tolerable condition, knowledge of the limits of variation is not yet precise enough to warrant definite specific identification of these structures alone. In all probability *Agalma elegans* and *Stephanomia bijuga* are represented; very likely *S. rubra* also. But none of the easily recognizable bells or bracts of *A. okeni* were found. The condition of the material would not add, in any case, to what is already known of the morphology of any of these species. And from the geographic side, doubtful identification would be worse than none, for it is possible that other long stemmed physophores are also represented among the catches (e. g. *Apolemia*).

# PHYSOPHORIDAE Eschscholtz 1829.

## PHYSOPHORA Forskål 1775.

### PHYSOPHORA HYDROSTATICA Forskål 1775.

Fig. 49.

*Physsophora hydrostatica*, Forskål, 1775, p. 119; 1776, Pl. 33, Fig. E.
For synonymy, see Bigelow, 1911b, p. 293.

Material.

St. 43. 38°14′ N., 8°42′ E. 3. II. 1909.
  Y. 65 m w. Stem, palpons.
St. 57. 36°40′ N., 3°30′ W. 20. II. 1909.
  Y. 25 m w. Palpons.
  Y. 200 m w. Palpon.
St. 65. 35°53′ N., 7°26′ W. 24. II. 1909.
  Y. 65 m w. Stem; 8 nectoph.
  Y. 300 m w. Palpon; 2 nectoph.
  Y. 600 m w. Stem; palpons; 2 nectoph.
St. 66. 36°16′ N., 6°52′ W. 25. II. 1909.
  Y. 1200 m w. 2 nectoph.
St. 99. 36°02′ N., 5°16′ W. 23. VI. 1910.
  Y. 65 m w. Stem; palpons; 6 nectoph.
St. 116. 39°27′ N., 5°26′ E. 29. VI. 1910.
  Y. 25 m w. 1 nectoph.
St. 118. 41°00′ N., 6°43′ E. 30. VI. 1910.
  Y. 300 m w. Stem; palpons; nectoph.
St. 132. 38°57′ N., 9°47′ E. 14. VII. 1910.
  Y. 600 m w. 2 nectoph.
St. 195. 39°02′ N., 14°55′ E. 21. VIII. 1910.
  Y. 300 m w. 8 nectoph.
St. 199. 39°32′ N., 10°49′ E. 25. VIII. 1910.
  Y. 300 m w. Stem; palpons.
St. 204. 38°52′ N., 7°43′ E. 27. VIII. 1910.
  Y. 65 m w. Stem, 4 palpons; 4 nectoph.
  Y. 300 m w. 7 nectoph.
  Y. 1000 m w. Nectoph.
St. 205. 39°16′ N., 5°52′ E. 27. VII. 1910.
  Y. 25 m w. 1 nectoph.
St. 275. 39°05′ N., 14°50′ E. 3. IV. 1911.
  S. 94 m w. Stem; 21 palpons; 13 nectoph.

The specimens were all more or less fragmented. But the palpons, stem, and nectophores of *Physophora* are not only so characteristic in outline, but preserve so satisfactorily, that identification is easy, even when they are scattered loose among other plankton. The combination of a comparatively long and very slender nectosome sector, with a siphosome sector shortened and expanded into a voluminous terminal dilation showing clear evidence of the spiral twisting by which this contour has been developed, and with the points of attachment of each palpon appearing as a distinct polygonal facet, make even a denuded stem recognizable at a glance. No other known siphonophore has a stem of this form except Haeckel's *Discolabe quadrigata* which agrees with *P. hydrostatica* in all respects ex-

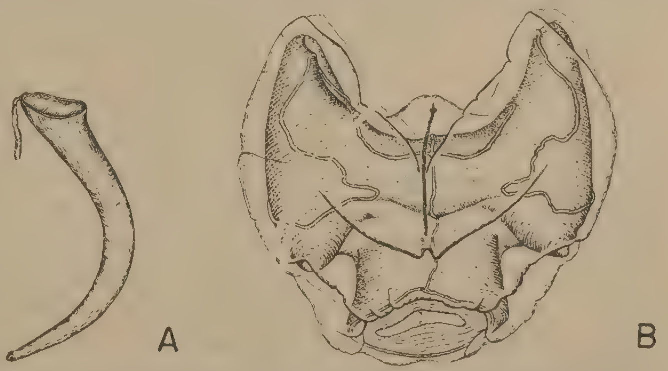

Fig. 49. *Physophora hydrostatica*; A. Palpon, 36 mm. long. B. Nectophore, 14.5 mm. wide, "Thor" St. 275.

cept in the quadriserial arrangement of its nectophores. And since such an arrangement never has been seen since Haeckel (1888b) reported and pictured it, the status of his supposed species remains doubtful. The large size, stoutness, and oblique basal truncation of the palpons (Fig. 49A) is likewise diagnostic. And details of conformation, especially the sub-angular lateral expansions of the nectosac on the oral side (but not of the gelatinous substance) combined with its deep emargination on the aboral side, make it possible to recognize loose nectophores (Fig. 49B) among other loose physophorid bells, with which they may be mingled in the tow. For accounts of the general morphology of *Physophora*, see especially Claus (1860), Sars (1877, p. 32, Pls. 5, 6, Figs. 1—8), and Chun (1897, p. 39, Pls. 2, 3, Figs. 3—6). For photographs of Pacific *Physophora*, see Bigelow (1911b, Pl. 16). The present series adds nothing to these earlier accounts, save for confirmation.

## ANTHOPHYSIDAE Brandt 1835.

### ANTHOPHYSA Brandt 1835.

### ?ANTHOPHYSA ROSEA Brandt 1835.

*Anthophysa rosea*, Brandt, 1835, p. 35.
For synonymy, see Bigelow, 1911b, p. 296; 1931, p. 577.

Material.

St. 218. 36°54′ N., 2°57′ E. 2. IX. 1910.
Y. 300 m w., one fragm. col.

This specimen shows the arrangement of the bracteal lamella characteristic of the genus, and most of the gonodendra are still intact. But it has lost all its bracts, while siphons, palpons, and tentacles, are represented by fragments only. Hence (since it is on these organs that possible specific differences are to be sought) it throws no more light on possible distinction between *Anthophysa* from the Pacific and Atlantic, than did the other Atlantic specimen most recently reported (Bigelow, 1931, p. 577). We can only say that, so far as gross morphology is concerned, we have found nothing to separate it from the well preserved series of *A. rosea* collected by the Albatross in the Eastern Tropical Pacific (Bigelow, 1911b, p. 296, Pl. 20, Figs. 7—13, Pl. 21, Figs. 1—5, Pl. 23, Figs. 1—5)., which strenghthens the presumption that *A. formosa* Fewkes is a synonym of *A. rosea*.

# RHIZOPHYSALIAE Chun 1882.

## RHIZOPHYSIDAE Brandt 1835.

### RHIZOPHYSA Peron and Lesueuer 1807.

It seems sufficiently established (Lens and Van Riemsdijk, 1908; Bigelow, 1911b) that all representatives of the genus recorded prior to 1925 were referable to two species, *eysenhardtii* Gegenbaur (1860), in which all the tentilla are simple-filiform, and *filiformis* Forskål (1775), in which most of the tentilla are trifid, but others (less numerous) either dendritic-palmate, or beak-like (Gegenbaur, 1853a, Pl. 18, Fig. 7—8; Fewkes, 1882, Pl. 6, Fig. 4; Lens and Van Riemsdijk, 1908, p. 101, Pl. 18, Fig. 45).

In 1925, Moser described two new species of *Rhizophysa*. One of these, her *R. tricornuta* like *R. filiformis*, has "vogelkopfartigen Tentakelknöpfen" (Moser, 1925, p. 445). According to Moser, the terminal median beak of her new species corresponds more closely to the terminal ampulla in the young tentillum of *Anthophysa* (Bigelow, 1911b, Pl. 20, Fig. 8), or of Agalmidae before the cnidoband has become spirally coiled, than to the terminal median structure in the beak-like tentilla of *R. filiformis*. But comparison of Haeckel's (1888 b, Pl. 24, Fig. 9) figure of the trifid tentillum of *R. filiformis*, and of the "Thor" examples of the latter, with Moser's (1925, Textfig. 59) illustration of tentilla of *tricornuta* fails to show any essential differences: the terminal structure is, in fact, only slightly more dilated in Moser's figure than it is shown by Haeckel, or than in the "Thor" example pictured in Fig. 50. And the lateral filaments show the same indication of incipient subdivision. We are, therefore, inclined to refer *tricornuta* to the synonymy of *filiformis*.

Moser's *R. megalocystis* is set apart by the possession of palpons ("Tentakeltaster", Moser, 1925, p. 447) bearing giant nematocyst capsules. As no corresponding structures have ever been described for *Rhizophysa*, it cannot be referred to that genus, but may belong to the genus *Salacia*, in which the polygastric cormidia are described by Haeckel (1888 b, p. 332) as bearing thin spindle shaped tubes, "perhaps palpons which remain permanently mouthless", as well as siphons.

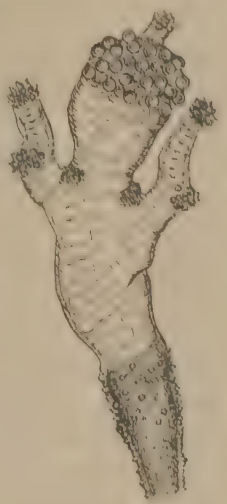
Fig. 50. *Rhizophysa filiformis*; Tentillum, from "Thor" St. 184. × 175.

## RHIZOPHYSA FILIFORMIS Forskål 1775.

Fig. 50.

*Physsophora filiformis* Forskål, 1775, p. 120; 1776, Pl. 33, Fig. F.
For synonymy, see Bigelow, 1911 b, p. 319.
? *Rhizophysa tricornuta*, Moser, 1925, p. 445, Pl. 33, Fig. 2.

Material.

St. 58. 36°36′ N., 4°24′ W. 20. II. 1909.
Y. 65 m w. Part of 1 col.
St. 184. 38°10′ N., 22°33′ E. 17. VIII. 1910.
Y. 65 m w. Part of 1 col.; loose siphons with tentacles.
St. 220. 36°25′ N., 0°42′ E. 4. IX. 1910.
Y. 25 m w. Parts of 2 col.
St. 223. 36°13′ N., 1°28′ W. 5. IX. 1910.
Y. 2000 m w. Parts of 2 col.
St. 225. 36°35′ N., 3°00′ W. 6. IX. 1910.
Y. 25 m w. Part of 1 col.

These specimens all still bear the large pneumatophore with the hypocystic villi plainly visible, some of the siphons, and parts of tentacles still bearing tentilla far enough advanced in development to show the trifid conformation, with expanded median ampulla, that predominates among the tentilla of this species (cf. Fig. 50 with Lens and Van Riemsdijk, 1908, Pl. 18, Fig. 142—144). The palmate and beak like forms that have been described in this species (see above, p. 64) were not to be seen on any of the "Thor" specimens, but no significance can be given to their apparent absence, as only the basal parts of the tentacles are intact on any of the specimens.

The material is not good enough to add anything to earlier accounts, see especially Gegenbaur (1853 a), Haeckel (1888 b, *Cannophysa murrayana*), and Lens and Van Riemsdijk (1908).

## RHIZOPHYSIDAE genus?

Material.

St. 138. 37°37′ N., 11°25′ E. 19. VII. 1910.
Y. 300 m w. Stem.
St. 141. 36°42′ N., 13°34′ E. 20. VII. 1910.

The condition of these fragments does not permit identification.

# CHONDROPHORAE Chamisso and Eysenhardt 1821.

## PORPITIDAE Brandt 1835.

### PORPITA Lamarck 1801.

#### PORPITA UMBELLA O. F. Müller 1776.

*Medusa umbella*, O. F. Müller, 1776, p. 295, Pl. 9, Fig. 2, 3.

For synonymy, see Bigelow, 1911 b, p. 352.

Material.

St. 160. 35°59′ N., 28°14′ E. 1. VIII. 1910.
Y. 25 m w. 1 col., 7.5 mm. in diameter, including limbus.

St. 340. 35°50′ N., 21°30′ E. 26. VIII. 1911.
S. 28 m w. 11 col., about 4—7 mm. in diameter of shell.

These few, small specimens add nothing to previous accounts of the morphology of *Porpita*. Until someone has the opportunity to compare a well preserved series of Atlantic with Indian Ocean *Porpita*, the former may continue as *umbella*. Should the two prove indistinguishable, as Moser (1925) believes, the compound species must be called *P. porpita* Linné, which was originally described from the Indian Ocean.

Successive studies (Bigelow, 1911 b, 1931) have yielded cumulative evidence that the *Porpita* of the Pacific or at least of the Eastern side of the latter, probably represent a distinct species, *P. pacifica* Lesson, separated from its Atlantic relative by the facts that the disc is strongly tuberculate, that the tentacular nematocyst-clusters average considerably more numerous, that there are fewer open stigmata, and that the limbar canals are more complex.

## VELELLIDAE Brandt 1835.

### VELELLA Lamarck 1801.

#### VELELLA VELELLA Linné 1775.

Fig. 51.

*Medusa velella* Linné, 1758, p. 660.

For synonymy see Bigelow, 1911 b, p. 352, (*Velella velella*), to which must now be added the synonymy for *V. lata* (see Bigelow, 1911 b, p. 343).

Material.

St. 204. 38°52′ N., 7°43′ E. 27. VIII. 1910.
Surface. 1 specimen, 31 mm.
St. 206. 39°32′ N., 5°15′ E. 28. VIII. 1910.
Surface. 32 specimens, 11—31 mm.

St. 217. 38°01′ N., 1°48′ E. 1. IX. 1910.
Surface. 5 specimens, 12—29 mm. in shell length.
St. 223. 36°13′ N., 1°28′ W. 5. IX. 1910.
Surface. 2 specimens, 6—11 mm. in greatest diameter.

Recent studies have lead to contradictory conclusions, as to whether the Velellas of the Atlantic and of the Pacific are distinct (Bigelow, 1911 b, p. 342) or are merely varieties of one wide-ranging form. The opportunity further to test this question, offered by the "Thor" series is therefore welcome. In an earlier comparison of Pacific with Atlantic specimens (Bigelow, 1911 b), supposed differences in the form of the crest were not borne out. Unfortunately, it was not possible to make any comparison of the outlines of the limbus which is entire in the Pacific specimens, but which has often been described as irregularly lobed in the Atlantic. But the shells of the Pacific specimens averaged relatively broader than any of the Atlantic specimens, proportional measurements being as follows:—

Atlantic:— Shell length, 11.5—30 mm.; breadth of shell relative to length, extremes, 1:2.7—1:3.1; average, 1:3.0.

Pacific:— Shell length 11—46 mm.; breadth of shell relative to length, extremes, 1:1.9—1:1.2; average, 1:2.1.

And as the shells of Pacific shells also seemed on the whole to be more nearly rectangular with the long sides straighter than those of the Atlantic species, retention of the two species seemed justified.

Measurements of the shells of the "Thor" series give the following results:—

| St. | Length mm. | Breadth mm. | Proportion breadth to length | St. | Length mm. | Breadth mm. | Proportion breadth to length |
|---|---|---|---|---|---|---|---|
| 223 | 3.5 | 2.0 | 1 : 1.8 | 206 | 18.5 | 7.0 | 1 : 2.6 |
| | 6.0 | 3.0 | 1 : 2.0 | | 18.5 | 7.0 | 1 : 2.6 |
| 206 | 8.5 | 3.0 | 1 : 2.8 | | 18.5 | 7.0 | 1 : 2.6 |
| | 12.0 | 5.0 | 1 : 2.4 | | 19.5 | 7.5 | 1 : 2.6 |
| | 13.0 | 5.0 | 1 : 2.6 | | 20.0 | 8.0 | 1 : 2.5 |
| | 14.0 | 5.5 | 1 : 2.5 | | 20.5 | 7.5 | 1 : 2.7 |
| | 14.0 | 6.0 | 1 : 2.3 | | 21.0 | 8.0 | 1 : 2.6 |
| | 14.0 | 6.0 | 1 : 2.3 | | 21.5 | 8.0 | 1 : 2.7 |
| | 16.5 | 6.5 | 1 : 2.4 | | 22.0 | 7.5 | 1 : 2.9 |
| | 16.5 | 6.5 | 1 : 2.4 | | 22.0 | 8.5 | 1 : 2.6 |
| | 17.5 | 7.0 | 1 : 2.5 | | 22.5 | 8.0 | 1 : 2.8 |
| | 18.0 | 6.5 | 1 : 2.8 | | 22.5 | 9.0 | 1 : 2.5 |
| | 18.0 | 7.0 | 1 : 2.6 | | 24.0 | 8.0 | 1 : 3.0 |
| | 18.0 | 7.0 | 1 : 2.6 | | 25.0 | 8.5 | 1 : 2.9 |
| | 18.0 | 6.5 | 1 : 2.8 | 204 | 24.0 | 9.0 | 1 : 2.4 |
| | 18.0 | 7.0 | 1 : 2.6 | 217 | 24.5 | 10.0 | 1 : 2.5 |
| | 18.5 | 7.5 | 1 : 2.5 | | 27.5 | 10.0 | 1 : 2.8 |
| | 18.5 | 7.5 | 1 : 2.5 | | 28.5 | 10.5 | 1 : 2.7 |

The extreme range for specimens with shells more than 8 mm. long is thus from 1:2.3 to 1:3.0 (mean, 1:2.6). As this mean (likewise the extremes) lies almost precisely midway between the means for Atlantic and Pacific series previously measured, no distinction can be longer maintained between the two. And this proves equally true of the outlines of the limbus, for most of the "Thor" series are in good enough condition to show that this is not lobed, but entire, just as it is in Pacific specimens. Lobing seems, therefore, to reflect either temporary contraction or the results of preservation. Of characters previously suggested as perhaps diagnostic, the form of the crest having already been tested and discarded (BIGELOW, 1911 b, p. 342), there remains only the form of the shell. And comparison of specimens of approximately equal sizes from the two oceans, shows that this is no more significant than is the proportion of breadth to length, for the earlier view that the shell of Pacific specimens were more rectangular, those of Atlantic more eliptical, can no longer be maintained, there being no significant difference in this respect (Fig. 51).

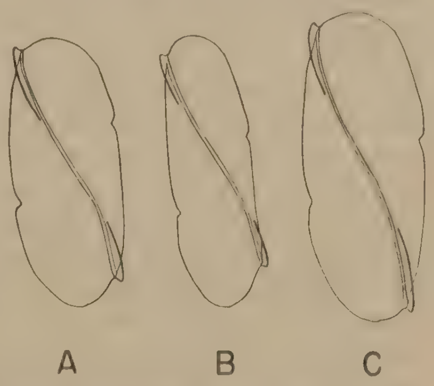

Fig. 51. *Velella velella*; dorsal view of the shells of three specimens showing variations in outline. A. Length, 21.5 mm., "Thor" St. 206, B. Length, 25 mm., "Thor" St. 206. C. Length, 27.5 mm. from Bonin Island (Mus. Comp. Zool. Cat. No. 1566).

In short, there is no longer any justification for recognizing a Pacific species of *Velella* as contrasted with an Atlantic, but the two must be united as MOSER (1925) has done under the old name *V. velella* LINNÉ. Presumably this applies to the *Velella* of the Indian Ocean, but the latter still has to be examined critically from this standpoint.

# PART II. BIOLOGICAL.

## INTRODUCTION.

The phases in the biology of siphonophores on which the "Thor" data throw light are, a) distribution, horizontal and vertical; b) fluctuations in abundance from season to season; c) breeding season and depth at which the chief production takes place.

## METHODS OF CALCULATION.

Primary data. Most of the catches were made in ordinary horizontal tows with Young Fish Trawls, of the same size (for description, see SCHMIDT, 1912, p. 8). The horizontal portions of the tows varied in duration from 15 to 240 minutes, the majority being of one half hour. In order to make the results comparable, it is necessary, as a first approximation, to reduce all catches to the basis of an equal towing period. For convenience, one hour was selected. In the case of the deeper hauls, the periods occupied in lowering and hauling in the nets, i. e., the oblique or vertical portions of the net's travel must also be taken into account. The station tables (SCHMIDT, 1912) contain no record of these times. But the corresponding linear distance for each tow would, obviously be twice the length of wire payed out. In order to combine this with the horizontal part of the tow, the latter must be translated from the time interval, in which it is stated in the tables (SCHMIDT, 1912), into the corresponding linear distance, the usual speed of the ship, while towing, being stated as two nautical miles per hour (SCHMIDT, 1912, p. 13).

If, for example, 1000 meters of wire were payed out, and the net towed 1 hour, the minimum linear distance would be 2000 meters plus 3700 meters (2 sea miles). Calculations on this basis, contain three unavoidable sources of error; — a) error resulting from variations in the speed of the ship; b) errors resulting from the fact that the travel of the net up and down was no doubt oblique; and c) the error inherent in the tow net method of collection. These errors may have been large for individual tows. But it is not likely that they seriously affect the average results in large numbers of tows. One may assume, to begin with that, with careful navigation, the average speed was close to the standard two knots. And while the second error becomes increasingly serious with increasing depth (nor can any definite estimate of its magnitude be arrived at), it is always in the same direction; i. e., the calculated length of a haul is the minimum in every case. As for the third source of error, general experience with large nets of the fabric actually used on the "Thor" (stramin), makes it likely that reasonably large catches of slow moving animals, too large to pass through the meshes, and distributed at random in the water, made in parallel hauls, would not show an average variation[1] of more than 25 °/₀ (WINSOR and WALFORD, 1936).

To be on the safe side, it is wise not to credit any significance to variations in unit catches of less than, say, 50—60 °/₀.

Except when otherwise stated, it is assumed that the number of calycophore colonies represented in any haul equals the number of complete specimens taken, added to the number of superior nectophores or of inferiors, whichever is the more numerous. The number of complete specimens added to the number of loose bracts similarly gives the number of eudoxids.

### Absolute Abundance.

For comparison with animals of other planktonic groups, some expression of absolute abundance is desirable, i. e., the number per unit volume of water, rather than per hour's tow. Exactness cannot be hoped for, in this respect, because of the unknown variations in the speed of the vessel and in the coefficient of filtration of the nets. However, assuming 3700 meters as the length of an hours tow, with a net with a rectangular mouth, 2 × 1.5 meters (Schmidt, 1912, p. 8), and assuming furthermore that the straining efficiency of the net be roughly 50 % (which is probably too low), the water strained in one hour would be about 5500 cubic meters. And while this estimate may very well be 50 %, in error, or even more, as anyone will realize who has had any experience with tow netting, absolute abundances so calculated yield comparative results of considerable interest.

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[1] Coefficient of variation.

## Vertical Distribution.

As all the hauls were made with open nets (the great majority with the Young Fish Trawl) which fish as effectively while being hauled in as while hauled horizontally, and only slightly less effectively while being payed out, it is obvious that part, or (in extreme cases) even the whole of the catch of a deep haul may actually have been taken close to the surface. During the early years of quantitative plankton investigations, various authors emphasized the magnitude of this contribution to the total catches of horizontal hauls with open nets, that may be made by what the net picks up on its way up and down. And it is obvious that if but a single haul were in question, there would be no way whatever of separating this part of the catch from what was made during the horizontal part of the tow. If, however, a number of hauls are made at different levels at a given station and if the area covered by the latter be not too large, differential results often do afford significant information as to vertical distribution (Murray and Hjort, 1912). If, for example, one species, or group of species, be caught only in the deep hauls (as is often the case), while the catch of another group is much larger in the shoalest hauls than in the deep, it is clear enough that the latter were (for the most part) living near the surface, but all of the former deep down in the water. All this is so obvious that there is no need to stress the point further.

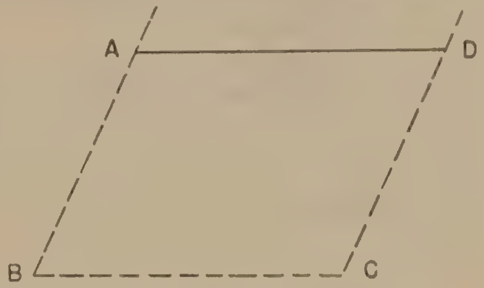

Fig. 52. Schematic representation of relationship between vertical and horizontal parts of hauls, at stations where only two were made shoal and deep.

Information of this sort becomes increasingly reliable, the smaller the vertical intervals between the hauls. This criterion was fulfilled better, perhaps, on the "Thor" cruises than on any previous expedition (at least for zooplanktonic animals so large that horizontal tows are needed for adequate sampling), because tows were made at many levels at many stations, at different times of year; because sizes of nets and duration of tows were accurately recorded; and because the speed of towing was kept approximately uniform (see above).

In evaluating the significance of catches, in terms of vertical distribution, for any given species, the point most definitely established is the upper limit to its regular occurrence — a matter often of great significance in the ecology of the species. Obviously, if it occurs up to the surface, it is caught at that level: if not, it is equally obvious that its upper boundary is near the shoalest depth at which it is caught consistently. From this depth downward, the picture becomes increasingly confused by the contamination of the hauls from successive levels, by individuals of the species picked up by the net on the way down or up. If, for example, an animal has its chief abundance in the 200—600 meter zone, catches in open nets from deeper levels would be significant only if too large to be explained in this way. A correction for this contamination, has therefore, to be subtracted from the total catches, before the latter can be used as illustrative of relative vertical distribution.

If the horizontal distribution of a given species were uniforn and random, if it increased in abundance downward in direct proportion to the increase in depth, and if its relative abundance at the shoalest level be known (from the tows at that level), the problem involved in calculating what part of the total catch in the next deeper haul actually came from the horizontal part of the latter might be illustrated in the accompanying diagram (Fig. 52), in which AD represents the upper level at which abundance is known, BC the level of the deeper tow for which the abundance is to be calculated, and the dotted line the course of the net through the water. On the above assumptions, the addition to the catch made during the journeys of the net up and down, will be equal to the average catch per unit length along the paths *AB* and *CD*, multiplied by the length *AB* plus *CD* (or 2 *AB*), this average being equal in turn to one half the sum of the unit catch at the upper level *AD* (known) and at the lower level *BC* (unknown).

The catch made along the paths *AB* plus *CD* may therefore be expressed as:—

$$F = \frac{(E+x)}{2}\,2Z = Z(E+x)$$

where

$F =$ Total catch along *AB* and *CD*
$E =$ Catch per unit length at the upper level, *AD*
$x =$ Catch per unit length at the lower level, *BC*
$Z =$ Length *AB* or *CD*
$L =$ Length *BC*
$T =$ Total number of organisms along $AB + BC + CD$

and, the total catch

$$T = F + xL.$$

By substitution

$$T = Z(E+x) + xL$$

$$x = \frac{T - EZ}{Z + L}.$$

When hauls are made at several levels (Fig. 53) at a given station, the calculation becomes cumulative downward, from level to level.

In this case,

$$F_1 = Z(E+x) + Z_1(x+x_1) + Z_2(x_1+x_2).$$

and

$$T_1 = F_1 + x_2 L$$

where

$Z_1 =$ Length $B_1B_2$ or $C_2C_1$
$Z_2 =$ Length $B_2B_3$ or $C_3C_2$
$F_1 =$ Total catch in length $AB_1B_2B_3$ and $C_3C_2C_1D$
$x_1 =$ Catch per unit length along $B_2C_2$
$x_2 =$ Catch per unit length along $B_3C_3$
$T_1 =$ Total catch made by the deepest tow along its entire course $AB_3C_3D$
$L_1 =$ Horizontal length of deepest tow, $B_3C_3$.

By substitution,

$$T_1 = x_2 L_1 + Z(E+x) + Z_1(x+x_1) + Z_2(x_1+x_2)$$

$$x_2 = \frac{T_1 - Z(E+x) - Z_1(x+x_1) - Z_2(x_1)}{L_1 + Z_2}.$$

The calculation for the catches of *Abylopsis tetragona* at St. 206 may serve as an illustration:—

In this case, the actual catches, lengths of wire out, and towing times were:— 25 meters of wire, 15 minutes, 53 colonies and loose inferior nectophores; 300 meters of wire, 15 minutes, 147 colonies and inferior nectophores; 1000 meters of wire, 45 minutes, 141 colonies and inferior nectophores; 2000 meters of wire, 45 minutes, 148 colonies and inferior nectophores.

The catch per unit length (1 meter) in the 25 meter tow being $\frac{53 \times 4}{3700} = 0.057$ or 212 per hour, (assuming that 1 hour's tow covered a distance of 3700 meters), the catch per meter with 300 meters of wire out was, $x = \frac{147 - 275\,(0.057)}{925 + 275} = 0.109$ or 403 per hour; the catch per meter with 1000 meters of wire out was

$$x_1 = \frac{141 - 275\,(0.057 + 0.109) - 700\,(0.109)}{2775 + 700} = 0.005 = \text{or 18 per hour}$$

the catch per meter with 2000 meters of wire out was

$$x_2 = \frac{148 - 275\,(0.057 + 0.109) - 700\,(0.109 + 0.005) - 1000\,(0.005)}{2775 + 1000} = 0.004 = \text{or 14 per hour.}$$

The hourly catches, uncorrected, would on the contrary, work out as follows in this case, were it assumed that the entire catch had been made in the horizontal part of each tow, i. e., while the recorded length of wire was out:— 25 meters of wire, 212 specimens per hour; 300 meters of wire out, 588 specimens per hour; 1000 meters of wire, 188 specimens per hour; 2000 meters of wire, 196 specimens per hour. There is therefore good ground for concluding that, in this case, the greater part of the "deep" catches came from the overlying strata, but that an appreciable number were actually living down to the deepest level sampled.

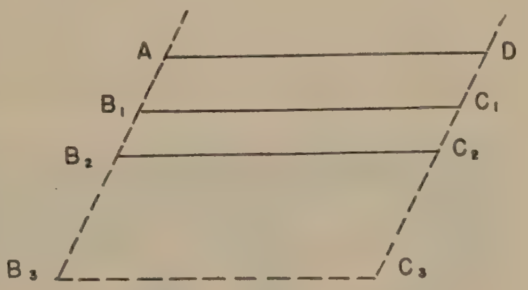

Fig. 53. Schematic representation of relationship between vertical and horizontal parts of tows at stations where tows were made at several levels.

In cases where the catches are large in the shoal hauls, but small at the deep, $x_1$, $x_2$, etc., often work out as minus quantities, meaning that the whole of the catches made in the deep hauls may very likely have been picked up by the nets in their passage down and up again through the densely populated upper layers. This applies, for example, to the calculation for *Chelophyes appendiculata*, at St. 115, where the catches were:— 25 meters of wire out, 15 minutes, 515 superior nectophores and complete colonies; 65 meters of wire, 15 minutes, 409 superior nectophores and colonies; 300 meters of wire, 30 minutes, 36 superior nectophores and colonies; 2000 meters of wire, 60 minutes, 61 superior nectophores and colonies; The catch per unit length (1 meter) with 25 meters wire being

$$\frac{515 \times 4}{3700} = 0.566, \text{ or 2060 per hour}$$

for 65 meters of wire,

$$x = \frac{409 - 40\,(0.556)}{925 + 40} = 0.390, \text{ or 1443 per hour}$$

for 300 meters of wire,

$$x_1 = \frac{36 - 40\,(0.556 + 0.390) - 235\,(0.390)}{1850 + 235} = -0.044 \text{ or 0 per hour}$$

for 2000 meters of wire,

$$x_2 = \frac{61 - 40\,(0.556 + 0.390) - 235\,(0.390 - 0) - 1700\,(0)}{3700 + 1700} = -0.012 \text{ or 0 per hour.}$$

It is obvious that stations where a species is not taken at all, may be omitted from calculations of its relative vertical abundance. This applies equally to stations where towing was done at one level only: in such cases, there is no way of knowing whether the species was more or less plentiful at some other level. Conversely, each tow must be taken into account whether yielding the species or not, at stations where several tows were made, and where any of them took it.

The following example will show how much the calculation for catches at deeper levels is affected by errors (p. 68) in the numerical estimate of the population at the shoaler level. If the catch of *Abylopsis tetragona*, St. 206, at 16 meters of 212 per hour had been 50 % less (106), the calculated catch would have been 429 instead of 403 per hour (6 % more) at 200 meters, 11 instead of 18 per hour (39 % less) at 666 meters, and 13 instead of 14 per hour (6 % less) at 1333 meters. If, on the other hand, the catch at 16 meters had been 50 % greater (318), the calculated catch would have been 381 instead of 403 at 200 meters (5 % less), 14 instead of 18 at 666 meters (22 % less), and would have remained about the same (14 per hour) at 1333 meters.

## General effects of introducing the correction for contamination from above into the calculations of relative vertical abundance.

The vertical distribution of any animal occupying a fairly wide bathic zone, as plotted directly from catches made in open nets, usually appears as extending downward to the level of the deepest tows (irrespective of whether it actually lives so deep or not), because of the specimens picked up by the nets on their way up and down. The narrow bands so often shown as extending downward from the polygon of chief abundance, in conventional diagrams of the sort reproduced in Figure 54, are cases in point. Application of the correction for contamination in the vertical portions of the tows, shows with a high degree of probability whether such bands are purely fictitious (resulting from inadequate data), as seems almost certainly to have been true in the case illustrated in Figure 54 A, or whether a sparse population does in fact extend downward for an indefinite distance below the level of major abundance, as in the case illustrated in Figure 54 B. Apart from this, the chief alteration that the introduction of the correction effects in the picture of vertical distribution is that it usually subtracts something from the apparent abundance in all but the uppermost stratum of occurrence, a subtraction usually increasing in amount with increasing depth. But if the horizontal parts of the tow, at the several levels combined, considerably exceed the combined vertical parts, the correction is seldom great enough seriously to alter the picture that would result without it, apart from more sharply defining the lower boundary to the occurrence of the species in question.

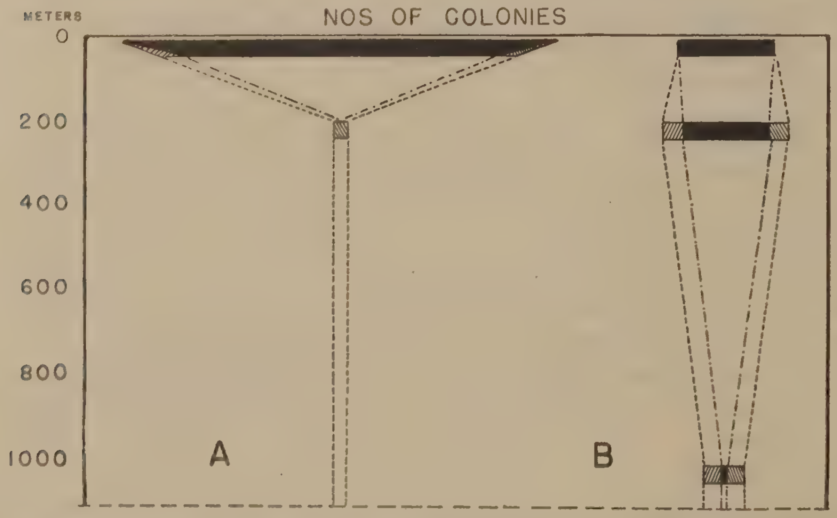

Fig. 54. Illustration of the effect of introducing the correction for contamination into calculations of vertical distribution. A. *Chelophyes appendiculata*, St. 115; B. *Abylopsis tetragona*, St. 206. The outer polygons represent vertical abundance, per hour's towing calculated without correction, the inner polygons, vertical abundance as corrected, the hatched areas being the difference between the two.

### Depths at which the nets were actually working.

In the station-tables, the hauls are described by the length of wire out, not directly in terms of depth, and it is these lengths which must be used in the calculations of contamination. In picturing vertical distribution, however, it is the depth at which the horizontal parts of the tows were made which is significant. For this, only a rough approximation can be made for the "Thor" hauls, because the wire-angle is not recorded. From experiments with a pressure gauge SCHMIDT (1912, p. 13) concludes that, at the standard speed of 2 sea-miles per hour, the actual depth of the "Thor" hauls was "somewhat greater than half the length of wire out". JESPERSEN (1915, p. 4) from experiments, concludes that the actual depth was "generally about two thirds" of the length of wire actually payed out. The estimate adopted in the present paper of depth equalling $^2/_3$ of the length of wire out, should therefore be regarded as maximal. The standard depths (so calculated), are 16, 43, 200, 400, 666, 800, 1066 and 1330 meters, the lengths of wire most frequently employed being 25, 65, 300, 600, 1000, 1200, 1600 and 2000 meters.

## NECTOPYRAMIS THETIS Bigelow (p. 5).

Fig. 55.

### Horizontal Distribution.

The localities of capture so far reported for colonies of *Nectopyramis thetis* are, Bay of Biscay (BIGELOW, 1911 a), between the Azores and the Canaries (LELOUP, 1933), and "Thor" St. 91 in the Bay of Cadiz (Fig. 55). The eudoxid has been recorded in the East Temperate Atlantic in August and September (LELOUP, 1932 a; 1933, p. 14), and at "Thor" St. 76 (in March) in the Bay of Biscay.

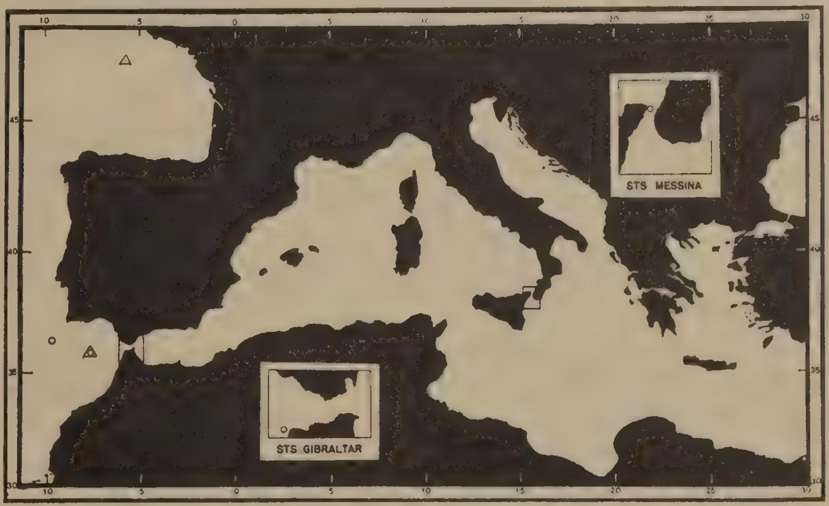

Fig. 55. "Thor" captures of *Nectopyramis thetis* (triangles) and *Amphicaryon acaule* (circles).

### Vertical Distribution.

All recorded captures, whether of the colonies, or of the eudoxid, have been in open nets, towed at considerable depths, namely; 300—0 fathoms in the Bay of Biscay (colony, BIGELOW, 1911 a); 1000—0 meters, Azores-Canaries (colony, LELOUP, 1933); 1600—0 meters, Bay of Cadiz (colony, "Thor" St. 91); between 1000—0 and 3000—0 meters, Bay of Biscay (eudoxid, LELOUP, 1933).

Evidently this is a bathypelagic species, but available data are not sufficient to show the level of most frequent occurrence.

## AMPHICARYON ACAULE Chun (p. 7).

Fig. 55.

### Horizontal Distribution.

This siphonophore is now known to be widespread in tropical and sub-tropical belts of all three great oceans (for a list of localities, see TOTTON, 1932, p. 330). While first described from the Canaries (CHUN,

1888) it was not taken again in that general region until 1909—1910, when the "Thor" found it outside the Straits of Gibraltar (Sts. 69, 96), and 1913 when the "Hirondelle II" had it in Lat. 38°58′ N., Long. 44°55′ W. (Leloup, 1933). The capture by the "Thor" of a specimen in the Straits of Messina (St. 282) is the first record for it in the Mediterranean (Fig. 55). Hence, as most of the early observations on siphonophores were made in this region, it must be a rarity there, probably a stray from the Atlantic.

### Vertical Distribution.

Previous depth-records from different regions are:—

Western Atlantic, open hauls between 50—0 and 600—0 meters (Bigelow, 1918);

Central Atlantic, along the track of the "Gauss", vertical hauls, 400—0 to 3000—0 meters (Moser, 1925);

Eastern Atlantic, between the Canaries and Straits of Gibraltar, 2000—0 meters (Leloup, 1933);

Indian Ocean, hauls from deeper than 180 meters, once in a closing net at 457—914 meters (Browne, 1926);

Off the Great Barrier Reef, Australia, 400—0 meters (Totton, 1932);

Eastern Tropical Pacific, open hauls from 550—0 meters (Bigelow, 1911b).

One of the four "Thor" catches was in a haul at 27 meters (1 colony), one from a 43 meter haul (9 superior nectophores, 6 inferior nectophores), one in a 200 meter haul (1 colony) and one in a 1066 meter haul (1 colony). A wide vertical range is thus established for the species, extending down at least to 450—500 meters and upward to within 40—50 meters of the surface, but apparently never rising actually to the surface. Data are not sufficient to show whether there is any prevailing level of maximum abundance, or how much deeper it may descend beyond the limit to which its presence has actually been proved.

## **ROSACEA CYMBIFORMIS** Delle Chiaje (p. 10).

Fig. 56.

### Horizontal Distribution.

*Rosacea cymbiformis* has been found in all oceans:— in the eastern Atlantic from the tropics northward to the Bay of Biscay (Chun, 1888; Haeckel, 1888b; Leloup, 1933), in the South Atlantic (Leloup, 1934; Leloup and Hentschel, 1935, Hardy and Gunther, 1935), in the Eastern Tropical Pacific (Bigelow, 1911b), in the vicinity of the Philippines (Bigelow, 1919), and in the Indian Ocean (Huxley, 1859; Browne, 1926). It has been taken more frequently in the Mediterranean than elsewhere, definite locality records there being:—

Nice — Leuckart (1853, 1854);

Naples — Delle Chiaje (1822), Keferstein and Ehlers (1861), Spagnolini (1868, 1870), Schmidtlein (1880), Korotneff (1884), Chun (1885), Schneider (1898), Naples Zool. Station, Moser (1917, 1923, 1925), Neppi (1921);

Capri — Lo Bianco (1903);

Messina — Gegenbaur (1854), Sars (1857), Moser (1917);

Villefranche — Fewkes (1879), Lochman (1914), Moser (1917, 1925), Leloup (1935);

Sicily — Delle Chiaje (1841);

Trieste — Graeffe (1884);

Mentone — Pagenstecher (1869).

On the "Thor" cruises, *R. cymbiformis* was taken at 1 station in the eastern basin of the Mediterranean (Gulf of Aegina, St. 183), at 6 stations in the Alboran Sea and the southern part of the Balearic Sea in the western basin, and in the Atlantic at 4 stations off the coast of Portugal and Southern Spain (Fig. 56).

### Vertical Distribution.

Although *R. cymbiformis* was never taken in large numbers and only at 11 "Thor" stations, there is some indication that it occurred most often at a depth greater than 50—100 meters, for the captures at 9 of the 11 stations were in tows from 200 meters and deeper while none were taken in the 16 or 43 meter hauls at these same stations. On the other hand the largest catch of all (152 nectophores per hour) was from close to the surface (St. 233, 16 meters), whereas most of the catches in the deeper tows were small, averaging only 20 nectophores per hour (uncorrected); — too few in fact for statistical analysis of vertical distribution.

Earlier depth-records for it have been even more divergent. On the one hand, it has been found floating at the surface so frequently, near Naples, that the local Zoological Station has supplied preserved specimens to many institutions. It has also been recorded in the upper 50 meters, at localities as far apart as the Canaries (Haeckel 1888b, surface, entire specimen), the Tropical South Atlantic (Haeckel, 1888b, p. 146, surface), off South Africa (Leloup and Hentschel, 1935, 0—50 meters), and in the Eastern Tropical Pacific (Bigelow, 1911b, surface, entire colony). On the other hand, the "Meteor" had it in closing net hauls from 50—100 and 200—400 meters. The "Discovery" took 2 specimens at 250—500 meters and one from 500—750 meters (Hardy and Gunther 1935), while the collections made by the Prince of Monaco contain scattering specimens in hauls from 0—1500, 0—2500, and 0—3000 meters; none, however, from surface hauls (Leloup, 1933, p. 8).

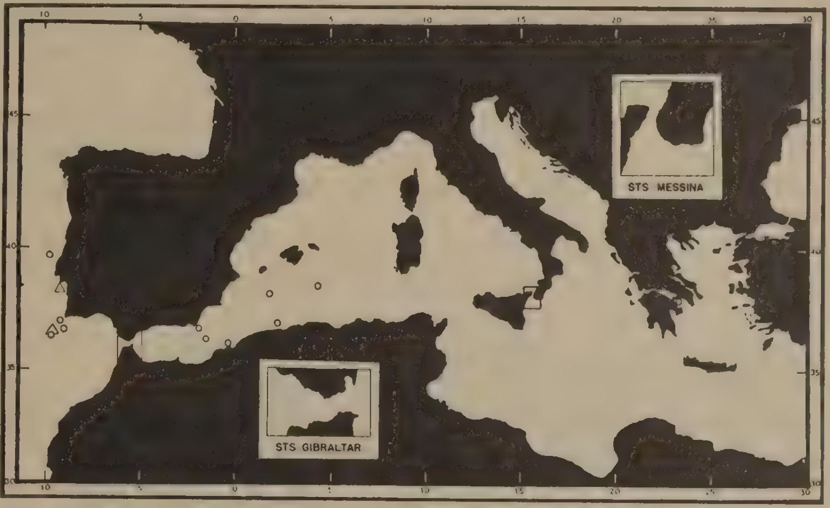

Fig. 56. "Thor" captures of *Rosacea cymbiformis* (circles) and *Rosacea plicata* (triangles).

Leloup and Hentschel (1935, p. 5) conclude that it "Gewässer mässiger Temperatur bevorzugt und deshalb um so bathypelagischer lebt, je mehr sie sich den tropischen Regionen nähert." This may well be the correct explanation for the fact that there is only one surface record for *cymbiformis* within the isothermal belt warmer than 25° C. And the identity of even this one is somewhat uncertain, for it rests on scattered bracts preserved in alcohol (Haeckel, 1888b, p. 146, "Challenger" St. 352, 10°55' N., 17°46' W.). However, it is not yet possible to state the upper limit of optimum temperature for it, in temperate latitudes where it does rise more regularly to the surface. Its appearances, there, near Naples, being mostly in winter and early spring are in water of 13—15° C. But temperatures as high as about 20° C. are certainly not fatal to it, for the rich catch at "Thor" St. 233, was from a temperature between 17° and 22.5° C.[1].

It may well be that storm waves are an effective bar to the continued existence of so fragile an animal, near the surface, as seems to be the case for the long stemmed physophores.

## Breeding Season and Abundance.

According to Lo Bianco (1899), this species breeds off Naples from January to May[2]. Haeckel also had ripe specimens in February, while Leloup (1935) reports it as common in winter and in spring at Villefranche. The "Thor" specimens are too few to yield any information as to seasonal fluctions in abundance.

The largest catch was at the rate of 152 nectophores per hour, or 137 per 5000 cubic meters of water.

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[1] Readings at 25 meters at the nearest stations (232, 234) where observations were obtained.

[2] Examination, at various hands, of specimens supplied by the Naples station has shown that the form listed by Lo Bianco (1899) as *Praya diphyes* Vogt was actually *R. cymbiformis*.

## ROSACEA PLICATA Quoy and Gaimard (p. 11)

Fig. 56.

### Horizontal Distribution.

Successive collections have extended the known range of this widespread species, which has now been taken in the open oceans at many localities; in the Temperate North Atlantic including the Bay of Biscay and Gulf of Gascony (CHUN, 1888; BIGELOW, 1911 a; LELOUP, 1933), in the South Atlantic and Subantarctic (LELOUP, 1934; LELOUP and HENTSCHEL, 1935; HARDY and GUNTHER, 1935), off the Great Barrier Reef, Australia (TOTTON, 1932, RUSSELL and COLMAN, 1935), in the Malaysian region (LENS and VAN RIEMSDIJK, 1908), and in the Northwestern and Eastern Tropical Pacific (BIGELOW, 1911 b; 1913). Originally described from the Straits of Gibraltar (QUOY and GAIMARD, 1827), it has often been listed from the Mediterranean under one or another of its several synonyms (p. 11). But the only Mediterranean records, the specific identity of which is definitely established by diagnostic descriptions or illustrations of specimens taken are:—

Nice — VOGT (1851, 1854);
Messina — KÖLLIKER (1853), KEFERSTEIN and EHLERS (1861).

And this species has so often been confused with *R. cymbiformis* that it is not wise to base geographic discussion on the older locality records, unless so supported.

The two "Thor" records, respectively 9 and 8 nectophores per hour, were from the Atlantic, near the coasts of Portugal and Spain (Fig. 56).

The fact that the "Thor" did not take it at all in the Mediterranean, in spite of the large amount of towing done there at all depths, shows that it must have been at least very rare there, if present at all, during the winter of 1908—1909 and summer of 1910. Nor do the older records suggest that it is ever as common as its relative *R. cymbiformis*, inside the Straits of Gibraltar.

### Vertical Distribution.

Most of the recent captures of this species have been from hauls from considerable depths:— Eastern Pacific, surface, 1 case, 550—0 meters 5 cases (BIGELOW, 1911 b); Northwest Pacific, hauls ranging between 366—0 and 2070—0 meters (BIGELOW, 1913); Great Barrier Reef, 80—0 meters (TOTTON, 1932; RUSSELL and COLMAN, 1931); Central and South Atlantic, 2500—0 and 3000—0 meters (LELOUP, 1933); 400—600 meters (LELOUP and HENTSCHEL, 1935); 400—0 and 666—0 meters ("Thor", p. 11); Bay of Biscay, 457—0, 550—0, 640—0, and 350—366 meters (BIGELOW, 1911 a). No doubt LELOUP (1933, p. 9) was therefore justified in characterizing it as "mésoplanktonique". Like most other siphonophores of this category, however, it appears at times at the surface: most often perhaps in regions of turbulent circulation like the Straits of Gibraltar (where it was originally found floating at the surface by QUOY and GAIMARD, 1827) and in the Straits of Messina.

Nothing is yet known of its relative abundance at different times of year, or of its breeding season.

## HIPPOPODIUS HIPPOPUS Forskål (p. 14).

Fig. 57.

### Horizontal Distribution.

*Hippopodius hippopus* is well known from all the warmer oceans (see MOSER, 1925 for a summary of its distribution). It was first found in the Mediterranean, and has since been reported there at the following localities:—

Mentone — PAGENSTECHER (1869);
Nice — VERANY (1846), VOGT (1851, 1854), LEUCKART (1853, 1854), MÜNTER (1912);

Straits of Gibraltar — Quoy and Gaimard (1827);

Capri — Lo Bianco (1903);

Naples — Otto (1823), Delle Chiaje (1828), O. G. Costa (1836), Sars (1857), Keferstein and Ehlers (1861), Spagnolini (1868, 1870), Pavesi (1869 . . .), Dönitz (1871), P. E. Müller (1871), Schmidtlein (1880), Bedot (1882), Weismann (1883), Korotneff (1884), Schneider (1898), Lo Bianco (1899), Richter (1907), Münter (1912), Chun (1913), Neppi (1921), Moser (1923);

Villefranche — Vogt (1851), Graeffe (1860), Metschnikoff (1874), Richter (1907), Münter (1912), Moser (1923, 1925), Leloup (1935);

Genoa — Verany (1846);

Sicily — Donitz (1871);

Messina — Kölliker (1853), Gegenbaur (1854), Sars (1857), Keferstein and Ehlers (1861), Claus (1863), Cialona (1901);

Western Basin — Leloup (1933, 7 stations).

Being already so widely recorded, it was not surprising to find it at 75 % of all the "Thor" stations in the Mediterranean (winter and summer) where tows were made at 43 meters or deeper, except in the Sea of Marmora and the Dardenelles region, where it was not encountered at all. In the Atlantic it was taken at 8 stations in the Bay of Cadiz and off Cape St. Vincent and at 1 station in the Bay of Biscay (or 22 % of the Atlantic stations) (Fig. 57).

Separation by localities and seasons shows it at 65 % of the western basin stations, and 79 % of the eastern basin stations in summer. In winter, it was taken at 80 % of the 30 stations in the western basin, but only at 2 of the 8 stations in the eastern basin. But with so few stations in this last group, it is doubtful whether such an apparent paucity was anything more than accidental. The chart shows that (with the exception just noted) there was no regional concentration of the stations where the nets failed to take it, or the reverse.

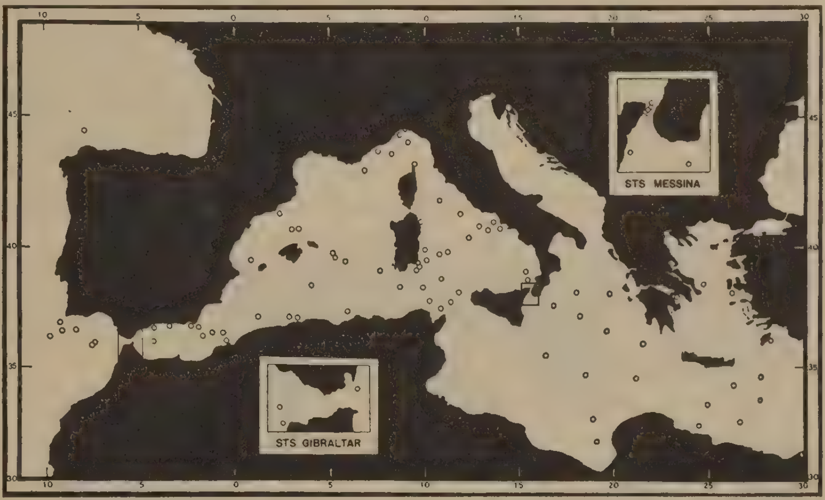

Fig. 57. "Thor" captures of *Hippopodius hippopus.*

### Vertical Distribution.

It has long been known that *H. hippopus* often appears right up to the surface, wherever it has been taken with any frequency, whether in the Mediterranean, or on the high seas. At Naples, according to Chun (1887, p. 13) it disappears from the surface at the beginning of summer. But few precise data exist as to its distribution downward, the records of colonies or of adult nectophores (other than those for the surface) having all been from open net hauls, except that one adult bell was taken by the "Meteor" in a closing net between 50 and 100 meters (Leloup, 1934, p. 5) and that Chun (1887, p. 13) reports occasional bells, in closing nets, down to 1200 meters.

The "Thor" catches of *Hippopodius* consist for the most part of loose nectophores, which may or may not have been connected when picked up by the net. Hence, — there being no way of knowing how many colonies may be represented in any given catch — the data do not afford as satisfactory a basis for analysis of vertical distribution, as they do for the diphyids, where the number of colonies is given by the number of superior nectophores.

In a rough way, however, the relative number of loose bells gives at least a rough indication of relative abundance, for it is obvious that a large number of nectophores represents more colonies than does a catch of only 3 or 4, which may all have come from a single colony. And *Hippopodius* bells are so large that one can be certain the samples contain at least the great majority of all that lay in the paths of the nets.[1]

At the 26 winter stations where taken in the Mediterranean (western and eastern basins combined) the average number of nectophores caught per hour (uncorrected) in hauls sent to different depths was as follows (Table 1), assuming all the catches to have been taken in the horizontal parts of the tows.

Table 1.

| Depth | No. of hauls | Extreme catches per hour | Mean catch per hour |
|---|---|---|---|
| 16 | 14 | 0—108 | 14 |
| 43 | 22 | 0— 90 | 19 |
| 200 | 14 | 0—300 | 34 |
| 333 + 400 | 6 | 0— 7 | 2 |
| 666 | 4 | 0— 5 | 1 |
| > 800 | 9 | 0— 3 | < 1 |

Even without attempting any correction for contamination, it is clear that the mean abundance, and also the maximum abundance, was of the same general order of magnitude from near the surface down to 200 meters, the apparent increase with increasing depth being perhaps due to contamination during the journey of the nets up and down.

But catches in the deep hauls were so small as to make it doubtful whether there were any significant numbers at depths much greater than 200 meters.

Hauls from June up to mid-August, show much this same type of vertical distribution, i. e., one of comparative uniformity down to 200 meters, but few or none at greater depths, as follows (Table 2).

But by August 21—September 7, when the "Thor" returned to the western basin, the catch per hour (uncorrected) was about 4 times as great in the 16 meter hauls (13 hauls, average uncorrected catch per hour, 24; maximum, 122) as in the 200 meter hauls (8 hauls, average uncorrected catch per hour, 6; maximum, 36), suggesting a seasonal alternation, between comparatively uniform distribution down to 200 meters from winter through early summer, and a preponderance in the upper strata in the late summer and early autumn. This, however, throws no light on the presence or absence of *Hippopodius* at the surface at different seasons, our only precise information on this point being Chun's (1887, p. 13) statement that near Naples, it "mit Beginn des Sommers von der Oberfläche verschwindet",

Table 2.

| Depth | No. of hauls at stations where taken | Extreme catches per hour uncorrected | Mean catch per hour uncorrected |
|---|---|---|---|
| 16 | 20 | 0—44 | 9 |
| 43 | 11 | 0—24 | 6 |
| 200 | 26 | 0—48 | 10 |
| 400 | 5 | 0—18 | 4 |
| 666 | 8 | 0—12 | 3 |
| 800 | 2 | 0— 5 | 2 |
| 1333 | 4 | 0 | 0 |

The Atlantic catches (104 nectophores, from 14 hauls, varying between 16—0 and 1066—0 meters) were too scattered for calculation of relative numbers at different depths. But since 881 of the nectophores were caught in hauls not deeper than 200 meters, it seems that distribution was essentially the same there as in the Mediterranean, i. e. concentrated chiefly in the upper 200 meter stratum.

## Breeding Season.

The larvae of this species have been found near Naples by Chun (1913) in August and September; in the Bay of Biscay in July (Bigelow, 1911 a); at various Atlantic stations between Latitudes 0° and 18° N. in December, March, April, and October, and in the South Atlantic, south to 48° S., in December, May, July, August, and October (Leloup and Hentschel, 1935), a distribution wide enough to suggest that

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[1] The only error, on this score, would be the failure of the nets to filter completely, which is not serious with mesh as large as was used on the "Thor".

*Hippopodius* reproduces more or less throughout the year, wherever it is a year-round resident[1]. This accords with the fact that the "Thor" tows do not show any great seasonal variation in abundance for the Mediterranean. At most, somewhat larger catches, both mean and maximal, in winter than in summer or in early autumn, may point to somewhat more active multiplication in autumn than at other times of year[2].

Moser (1925, p. 413), judging from the depth-distribution of the larvae taken by the "Gauss", and by the "Research" in the Bay of Biscay (Bigelow, 1911 a), concluded that the young stages, like the grown colonies "unterschiedslos Tiefe und Oberfläche bewohnt". The fact that the depth distribution of 10 larvae obtained by the "Meteor" (Leloup, 1934, p. 5) includes a haul as shoal as 50—0 meters and also a closing net haul as deep at 600—400 meters points similarly to a wide vertical range. Neither do the "Thor" records suggest any tendency for larvae of *Hippopodius* either to rise toward the surface (as do the young of various other siphonophores) or to concentrate at any particular level, the distribution of adults being nearly uniform vertically throughout the depth zone of regular occurrence, i. e., down to about 200 meters.

The fact that the material consists for the most part of loose nectophores prevents any estimate of absolute abundance of colonies. The largest catch was at the rate of 380 nectophores per hour, or 342 per 5000 cubic meters. According to Chun (1887, p. 13) this is one of the more common siphonophores off Naples.

## VOGTIA GLABRA Bigelow (p. 17).

Fig. 58.

### Distribution.

This species, originally described from the Straits of Florida (Bigelow, 1918), has subsequently been taken in the eastern side of the Temperate Atlantic between the Azores, Canaries, and coast of Portugal and Gulf of Gascony, and at one station in the western Mediterranean near Monaco (Leloup, 1933). It has never been reported from the other oceans, but it is likely eventually to prove as widespread as other members of its genus are known to be. One "Thor" catch (St. 186) shows that its Mediterranean range extends to the eastern basin. The others are from parts of the Atlantic where Leloup's (1933) records had already revealed its existence. It seems that *V. glabra*, like other Vogtias, is bathypelagic, all the recorded captures having been made in open hauls from 200 meters or deeper (mostly from hauls deeper than 400 meters) except for one "Thor" catch from 43 meters (St. 69) (Fig. 58).

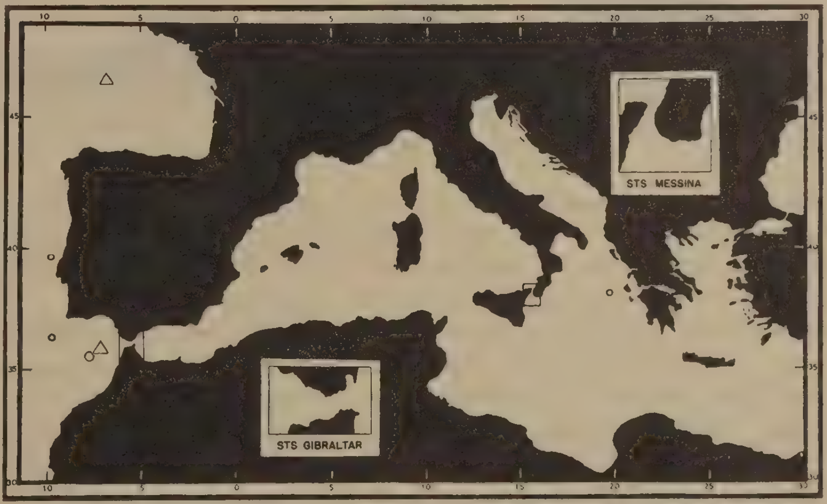

Fig. 58. "Thor" captures of *Vogtia glabra* (circles) and *Vogtia serrata* (triangles).

Leloup's (1933) records cover the months of April, August, and September, the "Thor" records, February, March, June, and August, enough to show that it is to be expected at any time of year. Further than this nothing can yet be said as to relative seasonal abunddance, or other phases in its life history.

This is no evidence that this species is ever abundant; the largest "Thor" catch was at the rate of 72 nectophores per 5000 cubic meters of water.

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[1] This would not refer to localities where it may appear in summer only, with the vernal expansions of warm currents.

[2] Leloup (1935) records it as common in the plankton at Villefranche during the winter and spring (March—May).

## VOGTIA PENTACANTHA Kölliker (p. 18).

Fig. 59.

### Horizontal Distribution.

Earlier records of *Vogtia* which can be assigned definitely to *pentacantha* as defined above (p. 18) are confined to the Mediterranean (Naples, Villefranche, and Messina, Kölliker, 1853; Gegenbaur, 1854; Keferstein and Ehlers, 1861; Claus, 1863; Moser, 1923, 1925; Leloup, 1935), the North Equatorial Atlantic current (Chun, 1897); the Straits of Florida (Bigelow, 1918), the Bay of Biscay (Bigelow, 1911 a), and to the Tropical Indian Ocean (Browne, 1926). Although the total number of specimens so far seen is very small, this species is evidently widespread, as are the other siphonophores of the mid-depths. The "Thor" records (p. 18) of positive identity (Fig. 59) extend its known range over the western basin of the Mediterranean, and to the southern side of the eastern basin, showing that it probably occurs generally throughout the Mediterranean, in the deeper strata. And addition of the locality records for nectophores of somewhat doubtful identity would include the Straits of Messina (type locality for the species), likewise the northern side of the eastern basin (St. 160). But there is no evidence so far, that any centers of local abundance ever develop for it within the Mediterranean, for the older accounts were all based on scattering individuals. Thus Keferstein and Ehlers (1861) mention a maximum of 4 colonies in one day, while the largest "Thor" catch of 14 loose nectophores (St. 122) could be explained by the fragmentation of not more than two or three colonies. In this its Mediterranean status corresponds to that of *V. spinosa* (p. 82). But lacking evidence of any richer population outside the Straits of Gibraltar, it is as likely that the sparse population inside the Straits is supplied by local production as that it draws from immigration from the Atlantic. The vertical distribution of the species argues in fact, against the latter possibility.

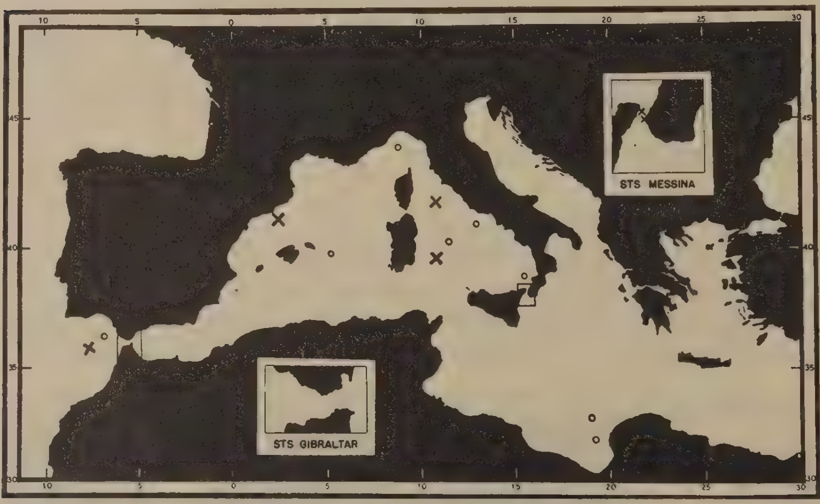

Fig. 59. "Thor" captures of *Vogtia pentacantha*, positive identification marked by circles; less certain identifications by crosses.

The old records for Messina (September, October, November, December, January, March, and April) cover the part of the year through which Kölliker (1853), Gegenbaur (1854), Keferstein and Ehlers (1861), and Claus (1863) carried on their studies there. Addition to the foregoing of the "Thor" catches (1 in January, 2 in March, 1 in June, 6 in July, 7 in August) shows that it is present in the Mediterranean the year round, with no apparent predominance at any particular season.

### Vertical Distribution.

Previous depth records for *V. pentacantha* fall into two groups; a) the early records from Messina which were from the surface; and b) all the subsequent captures, which have invariably been in hauls reaching down to 400 meters or deeper. All the positive "Thor" records were also from hauls from 200 meters or deeper; also most of the doubtful records, the only exception being 2 catches in 26 meter tows in the Straits of Messina. This corroborates Moser's (1925, p. 418) characterization of it as a "Tiefseeform". The only locality where it has been known to rise close to the surface is the Straits of Messina[1]; no doubt it is brought up there by the turbulent currents, as are various other bathypelagic animals. The vertical distribution of the "Thor" catches in the Mediterranean, including the doubtful examples, is as follows, assuming (as in the case of *V. spinosa*, p. 82) that the entire catch was made in the horizontal part of the haul, in each case, i. e. without correction (Table 3).

Table 3.

| Depth | No. of hauls at stations where taken | Extreme catches per hour | Nectophores per hour | % of hauls taking the nectophores |
|---|---|---|---|---|
| 16 | 11 | 0 | 0 | 0 |
| 26 | 7 | 0— 9 | 1 | 42 |
| 43 | 5 | 0 | 0 | 0 |
| 200 | 8 | 0— 1 | 1 | 12 |
| 400 | 7 | 0— 8 | 1 | 14 |
| 666 | 6 | 0—112 | 27 | 83 |
| 800 | 3 | 4— 54 | 16 | 100 |
| 933 | 1 | 49 | 49 | 100 |
| 1066 | 3 | 6— 19 | 12 | 100 |
| 1333 | 1 | 12 | 12 | 100 |

It is not possible to calculate the probable contamination of the individual hauls, because *V. pentacantha* was caught in only one haul at each of the stations where it was taken. And to base such a correction on average catches for the several depths might not be significant. But the fact that the catches were so small and the records so few in hauls from less than 600 meters, is evidence that the majority of the deeper catches were actually made in the horizontal parts of the tows, or at least near the indicated depths. The tabulation thus affords strong evidence that in summer the greater part of the stock of this species in the Mediterranean lives deeper than 400 meters, but that it is less numerous again below 1000 meters or so. The one Atlantic record was also deep — 8 nectophores for an 800 meter-haul (St. 66).

### Breeding Season and Depth, and Abundance.

Larval bells of this species have not yet been seen. Neither are the recorded captures numerous enough to throw much light on the relative abundance at different seasons. The presence of small numbers in the Mediterranean, winter as well as summer (p. 18), but never, it seems, of large numbers there at any season, suggests that reproduction takes place more or less evenly throughout the year. And the fact that it is only in exceptional localities, e. g., Straits of Messina, that this species ever appears at the surface is evidence that larval stages like the adult life are passed in deep water.

Judging from a maximum catch of 112 nectophores per hour (101 per 5000 cubic meters), this species is somewhat more abundant in the regions covered, than is *V. spinosa* (p. 82).

## **VOGTIA SERRATA** Moser (p. 19).

Fig. 58.

### Distribution.

It is probable that this is the most widespread *Vogtia*, for while it was only in 1925 that Moser pointed out its distinguishing characters as a new species, its range (including older records definitely referable to it) is already known to include the eastern side of the Atlantic generally, from the Gulf of Gascony and between the Azores and Canaries, south to Latitude 53° S. (Moser, 1925; Leloup, 1933; Hardy and Gunther, 1935), the Subantarctic (Moser, 1925), Tropical Indian Ocean (Madagascar, Moser, 1925), Sea of Okhotsk, Northwestern Pacific and the Eastern Tropical Pacific (Bigelow, 1913, 1931). Moser's (1925, p. 421) characterization of it as "Kosmopolit im weitesten Sinne des Wortes" was therefore fully justified, for the open oceans. But it is still uncertain whether or not, it occurs in the Mediterranean, for it is not clear whether Moser's (1925, p. 409) mention of 2 specimens from Monaco refers to this species or to *V. pentacantha*.

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[1] Leloup (1935, p. 6) records it as rising to the surface in the harbor of Villefranche where bathypelagic animals regularly occur (Leloup 1935, p. 1).

The failure of the "Thor" to take it in the Mediterranean may have been only accidental in view of the fact that it was taken only at two stations in all. One of these in the Bay of Cadiz (St. 65) lies well within the latitudinal limits covered by earlier records. The other (St. 242, Lat. 46°19′ N.) extends its known range somewhat farther north (Fig. 58). The depth of the two "Thor" hauls (1066 meters and 2900 meters) is in line with earlier information to the effect that this species usually lives at considerable depths, though occasionally appearing at the surface (Moser, 1925, p. 421).

## VOGTIA SPINOSA Keferstein and Ehlers (p. 18).

Fig. 60.

### Horizontal Distribution.

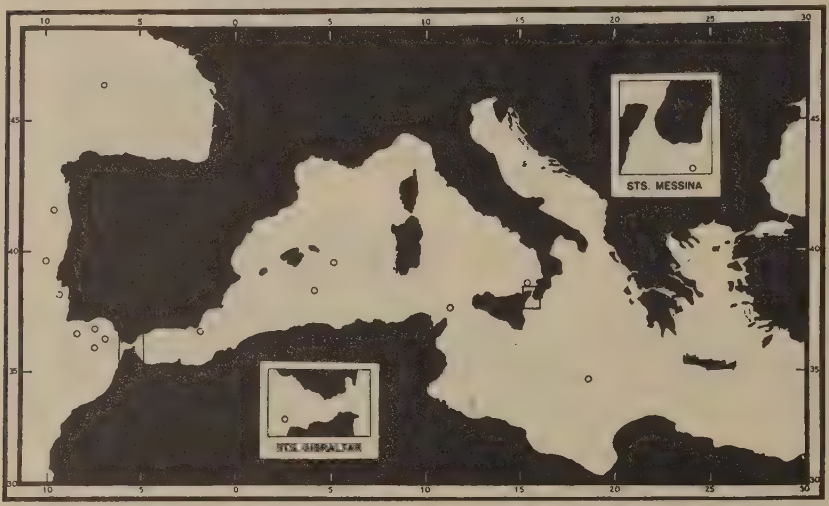

Fig. 60. "Thor" captures of *Vogtia spinosa*.

Previous records for this species, the type locality of which is off the coast of Brazil (Keferstein and Ehlers, 1861), are the Eastern Tropical Pacific (Bigelow, 1911 b; 1931), coast of California (Bigelow and Leslie, 1930), South Atlantic (Haeckel, 1888; Moser, 1925), and the Eastern North Atlantic, near the Azores, off Spain, and in the Bay of Biscay (Bigelow, 1911 a; Leloup, 1933). Captures by the "Thor" at 4 stations in the Bay of Cadiz, 3 stations along the coasts of Portugal and Spain, and one station in the Bay of Biscay call for no comment. There was no previous report of it in the Mediterranean. The "Thor" series of loose nectophores (p. 18) shows that actually it is sparsely distributed there, both in the western basin (5 stations) and in the eastern basin (2 stations) though not yet found in the tributaries of the latter (Fig. 60). But since the largest catch of nectophores[1] probably did not represent more than 3—5 colonies, there is no evidence of any center of abundance for it, or for a sustained production, within the Mediterranean. This makes it likely that the continued presence there of *spinosa* may be largely dependant on occasional immigration via the Straits of Gibraltar, even though the normally bathypelagic nature of this species suggests that it must be a rare event for any large number to rise to within the sweep of the inflowing current. Its failure to appear in earlier collections from the Mediterranean was no doubt due in part to actual scarcity, but more to the fact that it rarely rises to the upper water layers.

### Vertical Distribution.

Moser (1925, p. 420) has already emphasized the fact that 3 only, of the captures of *spinosa* up to that time, had been from the surface. Those by the "Arcturus" were in open hauls from 250—0, 1274—0, 545—0, and 272—0 meters (Bigelow, 1931); Leloup's (1933) records were in open hauls from 1000 and 5000 meters; and the shoalest capture by the "Thor" was in a haul with 500 meters of wire out. Successive proof has thus accumulated that this is a bathypelagic species confined chiefly to depths greater than 300—400 meters.

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[1] Loose nectophores alone were taken.

If it be assumed that the whole of the catch was taken in each case in the horizontal part of the tow (i. e., that none at all were picked up by the net on its way down or up), the mean catch per hour at Atlantic and Mediterranean stations where it occurred, combined, was as follows (Table 4).

Table 4.

| Depth | No. of hauls | Extreme catches per hour | Nectophores per hour | % of hauls with nectophores |
|---|---|---|---|---|
| 16 | 15 | 0 | 0 | 0 |
| 43 | 10 | 0 | 0 | 0 |
| 200 | 15 | 0 | 0 | 0 |
| 333 | 1 | 14 | 14 | 100 |
| 400 | 5 | 1—22 | 9 | 100 |
| 533 | 2 | 10—25 | 17 | 100 |
| 666 | 4 | 6—30 | 13 | 100 |
| 800 | 3 | 1— 4 | 1 | 66 |
| 1066 | 2 | 8 | 4 | 50 |
| 1333 | 2 | 2— 3 | 3 | 100 |

Six nectophores were also taken in an hours tow to 3875 meters (4350 m. wire) with a different net. Bearing in mind the strong probability that part of the catches in the deeper hauls were actually made at depths smaller than those listed, above, and that this probability increases with increasing depth, the foregoing suggests somewhat greater abundance (or at least more regular occurrence) between 300 and 500 meters than deeper. The data are not sufficient to show the relative vertical abundance deeper than the 400 meter level, first because neither the number of catches, nor the number of nectophores caught was large enough, secondly, because *spinosa* was caught in one haul only at most of the stations (see list of Material, p. 18). There may have been occasional nectophores down to the greatest depth explored.

Separation of the Atlantic catches from the Mediterranean shows the situation to have been about the same in this respect for the sparser population inside the straits, as for the more abundant stock outside (Table 5).

Table 5.

| Depth | Catch of Nectophores (uncorrected) per hour | | | |
|---|---|---|---|---|
| | Atlantic | | Mediterranean | |
| | Tows at stations where taken | Catch per hour | Tows at stations where taken | Catch per hour |
| 16 | 6 | 0 | 7 | 0 |
| 43 | 7 | 0 | 3 | 0 |
| 200 | 7 | 0 | 7 | 0 |
| 333 | 1 | 14 | — | — |
| 400 | 5 | 73 | — | — |
| 533 | 1 | 30 | 1 | 25 |
| 666 | 2 | 18 | 3 | 11 |
| 800 | — | — | 2 | 3 |
| 1066 | 2 | 17 | — | — |
| 1333 | — | — | 3 | 7 |

### Seasonal Variation.

*V. spinosa* was taken in the Atlantic on both the summer and the winter cruises, catches for the two seasons being of the same general order of magnitude. The Mediterranean captures, on the contrary were confined to the summer cruises. But it is not safe to generalize, as to seasonal occurrence, from comparison of summer data for one year with winter data for another, in the case of an animal as sparsely represented as *V. spinosa* was.

An average catch, at the most productive depth of only about 15 nectophores — or perhaps 2—3 colonies — per hour and a maximum of only 50 nectophores per hour, show that *V. spinosa* was one of the less abundant species.

## **VOGTIA** species? (p. 19).

### Horizontal Distribution.

Station records for nectophores of *Vogtia* too damaged for specific identification, corroborate the evidence set forth under the several species (p. 79, 80, 81, 82) that the genus is widespread throughout the western basin, and in the neighboring side of the eastern basin, but perhaps not farther east.

### Vertical Distribution.

The vertical distribution of the catches (Atlantic and Mediterranean combined) at different levels at the stations where such nectophores were taken, was as follows (Table 6), assuming the whole catch to have been made in the horizontal part of the haul in each case.

Table 6.

| Depth | No. hauls | Total nectophores | Total No. of nectophores per hour | °/o of hauls taking nectophores |
|---|---|---|---|---|
| 16 | 23 | 7 | 1 | 8 |
| 43 | 12 | 4 | 1 | 8 |
| 200 | 24 | 9 | 1 | 12 |
| 400 | 8 | 87 | 11 | 100 |
| 666 | 10 | 61 | 9 | 60 |
| 800 | 3 | 41 | 20 | 66 |
| 1066 | 4 | 6 | 1 | 50 |
| 1333 | 5 | 5 | 1 | 20 |
| 2666 | 3 | 6 | 2 | 66 |

This analysis corroborates the evidence for the separate species that *Vogtia*, as a whole, is most numerous and occurs most regularly at considerable depths, only rarely in the upper 200 meters.

## ENNEAGONUM HYALINUM Quoy and Gaimard (p. 20).

Fig. 61.

### Horizontal Distribution.

*Enneagonum hyalinum* is widely distributed in warm waters:— Temperate Atlantic (Chun, 1888, 1897a; Haeckel, 1888b); Eastern Tropical Pacific (Bigelow, 1911b); Philippine waters (Bigelow, 1919); Malaysian region (Lens and Van Riemsdijk, 1908); Great Barrier Reef of Australia (Totton, 1932; Russell and Colman, 1935); east of Australia and coast of New Guinea (Huxley, 1859); Indian Ocean (Browne, 1926).

Though originally described from the Straits of Gibraltar and found by the early investigators in neighboring Atlantic waters, it is only within the last few years that it has been recorded from the Mediterranean proper, the Prince of Monaco (Leloup, 1933) having taken it at 9 stations, all between the Balearic Islands and the eastern portion of the Alboran Sea. The "Thor" captured it, often in quantity, in the Alboran Sea and along the northern coast of Africa as far east as the west coast of Sardinia (Fig. 61). In this sector, to the west of Longitude 5° E., and south of Lat. 38°30′ N., it was taken at 8 out 11 "Thor" winter stations where hauls were made at 43 meters or deeper, and at 10 out of 16 such summer stations, the records of capture (71 °/o of the "Thor" stations) being very generally distributed. But it was found at only three stations elsewhere in the western basin, and not at all in the eastern.

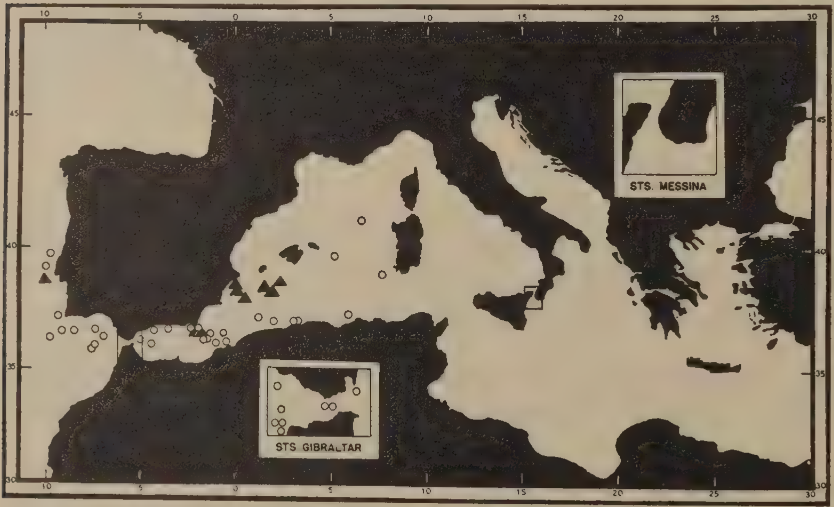

Fig. 61. Captures of *Enneagonum hyalinum* by the "Thor" (circles) and on the cruises of the Prince of Monaco (black triangles, data from Leloup, 1933).

Extending the survey to the Atlantic, we find *E. hyalinum* represented at 8 out of 9 winter stations (where hauls were made at 43 meters or deeper) in the Bay of Cadiz, along the coast of Portugal, and northward to Lat. 39°35′ N.; at 7 out of 8 such stations there in June, and at 2 out of 4 stations in September; but not farther north. It was thus as nearly universal in this general region in winter and early summer as in the extreme western part of the Mediterranean, and may have been equally so in September, when only a few hauls were made. But there was a decided contrast in abundance between catches made outside and inside the Straits, for, whereas the richest catches (corrected) in the Bay of Cadiz or Atlantic were at the rates of only about 17 nectophores per hour in February (St. 63), about 10 per hour in June (St. 95), and about 3 per hour in September, maxima inside the Mediterranean were 241 and 376 per hour for winter (Sts. 50, 59), 204 and 207 per hour in June (Sts. 99, 112), and 70 per hour in September (St. 222).

This picture of a more abundant population just inside the Straits than just outside, combined with the fact that this species is most plentiful at depths of 43 meters and deeper (p. 86), points to the existence at the time of the "Thor" cruises of a center of production in the western Mediterranean, contributing perhaps to the Bay of Cadiz via the deep outflowing current. Certainly there is no indication of any considerable or continuing immigration in the opposite direction, i. e., inward through the Straits, else we should expect to find *Enneagonum* distributed eastward, and more abundantly, along the axis of the inflowing current in the southern side of the western basin than on the Spanish side (cf. Fig. 61). However, the lack of any apparent feature in hydrography to explain the rather definite western boundary to its area of occurrence suggests that the presence of this species in the Mediterranean, at all, depends on occasional incursions of specimens caught up in the inflowing upper current. Once within the Straits these appear to find conditions more suitable for reproduction there than outside, as indicated by the fact that much larger numbers of eudoxids and of detached gonophores were taken at the stations inside the Mediterranean than in the Bay of Cadiz or neighboring stations in the Atlantic as just noted (p. 84), the contrast being shown for the average catches in Table 7.

Table 7.

| Depth | No. of cases | Mean no. of eudoxids outside Mediterranean corrected, per hour | No. of cases | Mean no. of eudoxids inside Mediterranean corrected, per hour |
|---|---|---|---|---|
| 16 | 18 | 2 | 5 | 115 |
| 43 | 12 | 1 | 7 | 44 |
| 66 + 133 + 200 | 9 | 9 | 7 | 157 |
| 333 + 400 + 533 | 6 | 6 | 2 | 86 |

Table 8.

| Depth | No.of hauls | No. of colonies per hour | | No. of eudoxids per hour | |
|---|---|---|---|---|---|
| | | Extreme[1] | Mean | Extreme | Mean |
| 1. Summer and winter combined. | | | | | |
| 16 | 20 | 0— 78 | 5 | 0—442 | 28 |
| 43 + 66 | 26 | 0—376 | 24 | 0—581 | 37 |
| 133 + 200 | 27 | 0—207 | 19 | 0—318 | 31 |
| 333 + 400 + 533 | 10 | 0—241 | 41 | 0—126 | 34 |
| 666 + 800 | 6 | 0— 51 | 15 | 0—104 | 13 |
| 1066 + 1333 | 10 | 0— 1 | < 1 | 0— 9 | 1 |
| 2. Winter only. | | | | | |
| 16 | 10 | 0— 78 | 8 | 0—442 | 51 |
| 43 + 66 | 14 | 0—376 | 27 | 0—581 | 50 |
| 133 + 200 | 10 | 0— 66 | 12 | 0— 68 | 15 |
| 333 + 400 + 533 | 10 | 0—241 | 41 | 0—126 | 34 |
| 666 + 800 | 2 | 2— 36 | 19 | 0— 7 | 3 |
| 1066 + 1333 | 2 | 0 | 0 | 0 | 0 |
| 3. June—September only. | | | | | |
| 16 | 10 | 0— 4 | 1 | 0 | 0 |
| 43 | 12 | 0—204 | 19 | 0—204 | 18 |
| 200 | 17 | 0—207 | 26 | 0—318 | 41 |
| 333 + 400 + 533 | — | — | — | — | — |
| 666 + 800 | 4 | 0— 51 | 14 | 0—104 | 26 |
| 1066 + 1333 | 8 | 0— 1 | < 1 | 0— 9 | 0 |

[1] In this calculation, 0 includes both cases where none at all were taken, and also the cases where the calculated contamination more than equalled the total catch, as explained on page 69. And this applies to all similar calculations in the following pages.

Its status in the Mediterranean, combined with Russell and Colman's (1935, p. 259) report of it in the Lagoon on the Great Barrier Reef at the time of year when salinity is as low as 33 ‰ or 34 ‰, shows that *Enneagonum* is able to survive a wide range, in this respect. But the "Thor" data combined with records of it on the high seas, do not support the supposition advanced by these authors (Russell and Colman, 1935, p. 271) that it is a coastal species.

## Vertical Distribution.

Catches per hour (corrected) at the 38 stations (both inside and outside the Straits of Gibraltar), where the species was taken, and where deep as well as shoal hauls were made, were as shown in Table 8.

According to this tabulation, colonies were decidedly less abundant in the upper 16 meters than at greater depths, winter as well as summer; this also applied to the eudoxids during the summer and early autumn, when they were not taken at all in the shallowest hauls. But in winter, eudoxids were most numerous in the upper 16—60 meters.

Further evidence as to regularity of occurrence as well as to relative abundance is afforded by the following tabulations a) of the relative frequency with which the hauls at different levels took it or missed it, and b) of the relative frequency with which the maximum catches at stations where the species occurred, were made in hauls from different depths.

Table 9. a) Hauls taking and failing to take *Enneagonum* at stations where it occurred at any level, and where both shoal and deep hauls were made.

| Depth | Total number of hauls | °/₀ of hauls in which it occurred |
|---|---|---|
| 16 | 20 | 30 |
| 43 + 66 | 26 | 46 |
| 133 + 200 | 27 | 77 |
| 333 + 400 + 533 | 10 | 70 |
| 666 + 800 | 6 | 83 |
| 1066 + 1333 | 10 | 20 |

Table 9. b) Relative frequency with which the maximum catches were made at different levels, at stations where the species occurrred at any level and where both shoal and deep hauls were made.

| Depth | Total No. of hauls | No. of cases in which maximum catch occurred at this level | °/₀ of cases in which the maximum catch occurred at this level |
|---|---|---|---|
| 16 | 20 | 3 | 15 |
| 43 + 66 | 26 | 8 | 30 |
| 133 + 200 | 27 | 16 | 58 |
| 333 + 400 + 533 | 10 | 5 | 50 |
| 666 + 800 | 6 | 3 | 50 |
| 1066 + 1333 | 10 | 1 | 10 |

Thus, whether judged by the mean catches per hour at the various levels, by the relative frequency with which the largest catches were made at the different levels, or by the frequency with which the species was taken at a given level, the "Thor" data show *E. hyalinum* as increasing in abundance, from near the surface downward.

Atlantic and Mediterranean catches, tabulated separately (below) show maximum abundance at about 100—500 meters, whether outside the straits, or inside. The Atlantic data then suggest an abrupt decrease, with increasing depth, whereas the Mediterranean catches do not show this decline until a depth of 800 meters was reached (Table 10).

Table 10.

| Depth | Atlantic | | | Mediterranean | | |
|---|---|---|---|---|---|---|
| | No. cases | Catch per hr. corrected | | No. cases | Catch per hr. corrected | |
| | | Nectophores | Eudoxids | | Nectophores | Eudoxis |
| 16 | 10 | 2 | 8 | 10 | 9 | 49 |
| 43 + 66 | 12 | <1 | <1 | 14 | 44 | 64 |
| 133 + 200 | 12 | 4 | 7 | 15 | 34 | 51 |
| 333 + 400 + 533 | 6 | 6 | 6 | 4 | 96 | 77 |
| 666 + 800 | 4 | <1 | 0 | 3 | 30 | 37 |
| 1066 + 1333 | 3 | <1 | 1 | 7 | 0 | 1 |

This wide range accords with previous data, for while there are numerous records of its colonies and eudoxids at the surface, or shoaler than 100 meters (Quoy & Gaimard, 1827; Huxley, 1859; Haeckel 1888b; Chun, 1892; Bigelow, 1911b, 1918; Leloup 1934), many other captures of it have been made in open hauls from considerable depths (Bigelow, 1911b, 1931; Moser, 1925; Leloup, 1933); one in a closing net from 1000—1200 meters (Chun, 1897).

### Seasonal Variations in Abundance.

The seasonal distribution of catches was as follows (Table 12). By these data, *Enneagonum* is about as plentiful in winter as in early summer in the Atlantic, as well as in the Mediterranean, but somewhat less plentiful in early autumn than in June.

Table 11.

|  | Number of stations where taken | Number of colonies per hour corrected |  | Number of eudoxids per hour corrected |  |
|---|---|---|---|---|---|
|  |  | Mean | Maximum | Mean | Maximum |
| Mediterranean |  |  |  |  |  |
| Winter | 10 | 36 | 376 | 69 | 581 |
| June | 7 | 30 | 207 | 50 | 318 |
| September | 5 | 7 | 70 | 13 | 100 |
| Atlantic |  |  |  |  |  |
| Winter | 8 | 3 | 17 | 3 | 43 |
| June | 7 | 3 | 16 | 2 | 11 |
| September | 2 | <1 | 3 | 0 | 0 |

### Reproduction.

a) Season. The captures of eudoxids at most of the stations where colonies were taken, Atlantic and Mediterranean, whether winter or summer, also at several stations which yielded no colonies, is sufficient proof that the species breeds to some extent throughout the periods of the year covered by the "Thor" cruises. And as the catches, whether of colonies or eudoxids, were of about the same orders of magnitude in June as in winter, it appears that production continues about equally active through the winter and early summer. But the falling off, in the numbers of colonies and eudoxids between June and September (p. 85) suggests that production slackens during the late summer and early autumn; perhaps it is entirely interrupted during the later autumn.

b) Depth. The vertical distribution of the eudoxids shown by the tabulation on p. 85, is evidence that reproduction takes place at one time or another throughout the whole depth stratum where colonies of the species occur in significant numbers, i. e., from close to the surface down to at least 600—700 meters. The fact that eudoxids were taken as abundantly close up to the surface in winter as at greater depths, but were not taken at all in the shoalest summer hauls, suggests that it is only in the cold season that the upper 20 meters or so serve as a nursery for it in these latitudes.

### Maximum abundance.

The richest catches (corrected) were at the rate of 376 colonies, and 581 eudoxids per hour (338 and 522 per 5000 cubic meters respectively).

## **ABYLOPSIS TETRAGONA** Otto (p. 23).

Fig. 62—64.

### Horizontal Distribution.

*Abylopsis tetragona* is common throughout the warmer zones of the oceans (see Moser, 1925). There are many locality records from the Mediterranean, particularly in the western basin, as follows:—

Straits of Gibraltar — Quoy and Gaimard (1827), Eschscholtz (1829), Gegenbaur (1860);
Malaga — Busch (1851);
Western basin — Leloup (1933, 37 stations);
Villefranche — Vogt (1854), Lochman (1914), Leloup (1935);
Nice — Verany (1846), Vogt (1854), Leuckart (1853, 1854), Graeffe (1860);
Naples — Delle Chiaje (1822), Otto (1823), O. G. Costa (1836), Gegenbaur (1854), Sars (1859), Keferstein and Ehlers (1861), Pavesi (1869 ...), Spagnolini (1870), P. E. Müller (1871), Schmidtlein (1880), Bedot (1882), Koretneff (1884), Chun (1885), Schneider (1898), Neppi (1921);

Capri — Lo Bianco (1903);
Messina — Kölliker (1853), Gegenbaur (1854), Sars (1857), Keferstein and Ehlers (1861);
Adriatic — off Ragusa, Lucietta, in the Pomo basin, Southern basin — Moser (1917);
Aegean Sea — Forbes (1844).

With this background, it was no surprise to find *A. tetragona* almost universal along the "Thor"s route in the western basin and Straits of Messina, winter as well as summer (77 out of 88 stations, or 87 °/o), also in the neighboring side of the eastern basin as far east as Longitude 19°30′ E. (taken at all 6 stations, Figs. 62, 63).

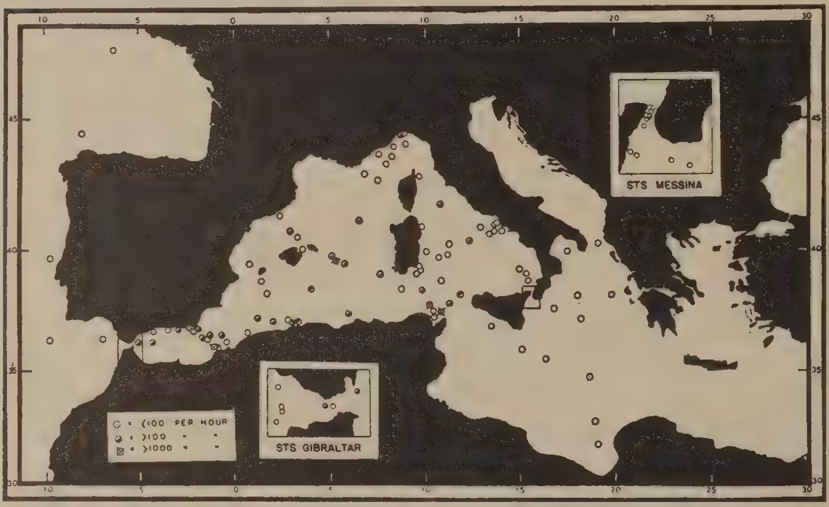

Fig. 62. "Thor" captures of colonies of *Abylopsis tetragona*.

Farther east, however, it failed altogether[1]. It was similarly much less frequent, in its occurrence in the neighboring parts of the Atlantic (only 5 out of 13 stations, always in small numbers), than in the western Mediterranean, which is thus proven a well marked center of distribution for it.

And the rather definite concentration of most of the rich catches (Fig. 62) shows that the southern part of this region supported a considerably more plentiful stock of *A. tetragona* than the northern, than the eastern half of the Mediterranean, or than the parts of the Atlantic traversed by the "Thor".

Eudoxids, similarly, were taken at stations widely scattered over the western basin, with most of the rich catches in the southern portion (including the Straits of Gibraltar), but at only one station outside the Straits (then only a scattering) and at 6 only in the eastern basin, all in the western part of the latter:— small numbers in each case.

This distribution of colonies and of eudoxids, combined, is good evidence that the population from the Pantellarian Channel westward is maintained by local reproduction independent of immigration from the Atlantic, and that the presence of the species in other parts of the Mediterranean depends largely on dispersal by the current system, from a rich center of production which extends from the Pantellarian Channel westward throughout the southern half of the western basin. But rich production centers may, likewise, develop locally around the northern shores, witness the rich catch of 1443 eudoxids of per hour (corrected) at St. 123, and the early accounts of them at Nice (Leuckart, 1853), Villefranche (Vogt, 1854), Naples and Messina (Gegenbaur, 1851; Keferstein and Ehlers, 1861). Why it is that *A. tetragona* is not carried in significant numbers to the most easterly parts of the Mediterranean is an interesting question to which no obvious answer is to be found in hydrologic conditions.

## Vertical Distribution.

An inspection of the list of captures (p. 23) is enough to show that they averaged much larger in the 16 and 43 meter tows than in those from greater depths, i. e., that the species reaches its maximum abundance

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[1] In this region there were 6 stations with tows deep enough to have taken it if it had been present in significant numbers.

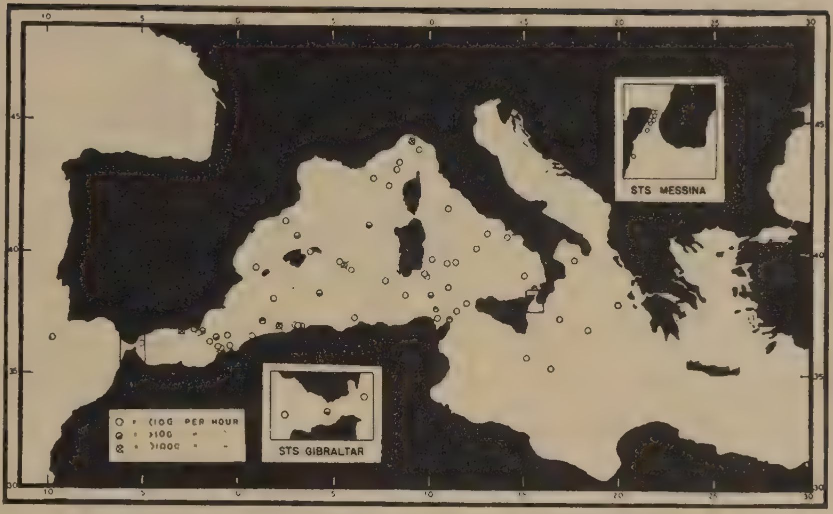

Fig. 63. "Thor" captures of eudoxids of *Abylopsis tetragona.*

close to the surface. It has long been clear, however, that the vertical range of the colonies of *A. tetragona* must be wide, for while these have been found in abundance at the surface at many localities in the tropical oceans, as well as in the Mediterranean, they have also been taken so often in deep hauls with open nets as to show that the species must also exist down to very considerable depths. The only previous data allowing calculation of the relative abundance at different levels are the vertical closing net catches by the "Meteor" expedition (Leloup and Hentschel, 1935), which show the following distribution with depth, at stations where tows were made at more than one level (Table 12). In the parts of the warm tropical Atlantic traversed by the "Meteor", *A. tetragona* was thus most abundant close to the surface and occurred with some regularity only down to 100—200 meters, with its lower boundary at perhaps 400—500 meters.

Table 12. "Meteor" catches.

| Depth | Meters of towing at stations where taken | Total catches | | Mean per 200 meters of towing | |
|---|---|---|---|---|---|
| | | Colonies & superior nectophores | Eudoxids and bracts | Colonies & superior nectophores | Eudoxids and bracts |
| 0— 50 | 400 | 16 | 20 | 8 | 10 |
| 50—100 | 750 | 9 | 9 | 2.6 | 2.6 |
| 100—200 | 200 | 2 | 2 | 2.0 | 2.0 |
| 200—400 | 1200 | 2 | 2 | 0.3 | 0.3 |
| 400—600 | 600 | 1 | 1 | 0.3 | 0.0 |
| >600 | 2000 | 0 | 0 | 0.0 | 0.0 |

The "Thor" data for the Atlantic, though scanty, suggest a similar concentration close to the surface, the calculated catch of colonies per hour (corrected) being as follows (Table 13), at the stations where the species was was taken there.

In the Mediterranean, however, the tabulation (Table 14) shows it as ranging down to a considerably greater depth, and as being perhaps abundant as deep as 300—400 meters as it was near the surface, a regional contrast of the same sort as revealed by the "Thor" data for *Chelophyes appendiculata* (p. 103).

For *A. tetragona*, as for other siphonophores, occasional catches much richer than those at neighboring stations, or than at adjacent levels at the same station, so confuse the picture of vertical distribution that the validity of generalization depends chiefly on the number of data available. For example, the large mean values for the 333 and 400 meter level, for winter, shown in the foregoing table, resulted from very rich catches at two stations, whereas catches at 4 other stations at this level at that season were at the rate of only 0—17 per hour. Similarly, all the winter catches at depths of 666 meters or greater, were 0, except for one at 800 meters of 99 per hour (St. 59); but this one brought the winter average for the deepest hauls up to 14 per hour. And the summer mean for nectophores at this depth would similarly be reduced to 20, by the elimination of one rich catch of 226 per hour at 1333 meters (St. 107). If allowance be made for

Table 13.

| Depth | No. of tows | Average catch per hour |
|---|---|---|
| 16 | 6 | 6 |
| 43 | 5 | 3 |
| 200 | 5 | 1 |
| 400 | 5 | 2 |
| 1066 | 1 | 0 |

Table 14.

| Depth | No. of hauls at stations where taken | Colonies per hour corrected | | | Eudoxids per hour corrected | | |
|---|---|---|---|---|---|---|---|
| | | Extremes | Mean | % of hauls taking *tetragona* | Extremes | Mean | % of hauls taking *tetragona* |
| | | Winter — Western basin. | | | | | |
| 16 | 13 | 0— 470 | 80 | 77 | 0— 100 | 10 | 23 |
| 43 | 14 | 0— 396 | 46 | 50 | 0— 48 | 4 | 36 |
| 133 + 200 + 266 | 19 | 0— 185 | 17 | 60 | 0— 16 | 1 | 27 |
| 333 + 400 | 6 | 0— 555 | 171 | 67 | 0— 2 | 1 | 17 |
| 666 | 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| >666 | 5 | 0— 19 | 19 | 20 | 0 | 0 | 0 |
| | | Summer — Western basin. | | | | | |
| 16 | 29 | 0—1660 | 202 | 83 | 0—1092 | 149 | 76 |
| 43 | 10 | 0—1690 | 261 | 90 | 0—2109 | 529 | 90 |
| 200 | 30 | 0— 740 | 109 | 80 | 0— 133 | 16 | 44 |
| 400 | 5 | 0— 140 | 50 | 40 | 0— 0 | 0 | 0 |
| 666 | 8 | 0— 141 | 31 | 50 | 0— 11 | 1 | 25 |
| >666 | 9 | 0— 226 | 36 | 44 | 0 | 0 | 0 |

such irregularities, it appears that while the nectophores of this species certainly occur in some numbers down to the deepest levels sampled by the "Thor", they usually averaged more numerous above than below 400 meters, winter as well as summer, and that in summer they were more than four times more numerous above 200 meters than at greater depths. The relative frequency of distribution as indicated by the percentage of hauls from different levels taking it, corrobates this, being definitely greatest in the upper 400 meters in winter, and in the upper 200 meters in summer.

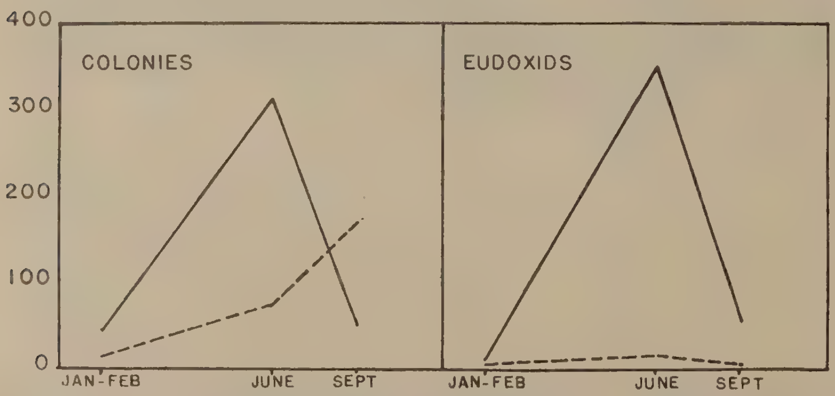

Fig. 64. Seasonal variation in vertical distribution of colonies and eudoxids of *Abylopsis tetragona*. Solid curves, mean catch per hour's towing at 16 and 43 meters combined, broken curves, mean catch per hour at 133, 200, and 266 meters combined, at stations where taken.

The eudoxids show a different distribution, being concentrated above 50 meters in winter, and many times as numerous there in summer, as at 200 meters. It is in fact doubtful whether the nets caught any eudoxids deeper than 200 meters at any season.

Segregation of the summer data by months (Table 15, Fig. 64) also shows a decided vertical shift in the center of population of colonies from the upper 50 meters in June to the 200 meter level in August—September, whereas the eudoxids continued most plentiful close to the surface.

This seasonal alteration in the abundance of colonies between the 50—0 and 200 meter levels suggests enrichment of the lower level between June and September by individuals dispersed down from the upper layers by the turbulent movements of the water which must necessarily play a governing role in the vertical distribution of any planktonic animal, unless the specific gravity of the latter differs considerably from that of the water, or unless it be strongly phototropic or rheotropic.

And this is corroborated by the evidence (from the fact that significant numbers of eudoxids occur only in the uppermost stratum) that production for this species is confined almost wholly to the upper 100

Table 15.

| Depth | June | | | August September | | |
|---|---|---|---|---|---|---|
| | No. of hauls, stations where taken | Catch per hour (corrected) | | No. of hauls, stations where taken | Catch per hour (corrected) | |
| | | Extremes | Mean | | Extremes | Mean |
| | | 1. Nectophores. | | | | |
| 16 + 43 | 25 | 0—1690 | 316 | 14 | 0—212 | 41 |
| 200 | 29 | 0— 329 | 75 | 11 | 0—740 | 169 |
| 400 + 666 | 7 | 0— 141 | 29 | 8 | 0—140 | 24 |
| > 666 | 5 | 0— 226 | 59 | 4 | 0— 26 | 7 |
| | | 2. Eudoxids. | | | | |
| 16 + 43 | 25 | 0—2109 | 353 | 14 | 0—488 | 57 |
| 200 | 19 | 0— 133 | 19 | 11 | 0— 55 | 11 |
| 400 + 666 | 7 | 0 | 0 | 8 | 0— 11 | 2 |
| > 666 | 5 | 0 | 0 | 4 | 0 | 0 |

meters or so; in other words that downward dispersal is almost wholly responsible for the presence of the species at greater depths. The fact that colonies of *A. tetragona* were found in such relatively large numbers down to a depth of 400 meters, thus gives a measure of the high degree of efficiency of this mechanical transport, unless counteracted by some factor inherent in the biology of the animal in question, there being no reason to suppose that this siphonophore reacts directionally to gravity. In the case of *Bassia* (p.94 ) for example, it evidently is so counteracted.

## Seasonal Variations in Abundance.

1. Colonies. According to the calculations of vertical abundance, tabulated above (p. 90, 91), colonies in the upper 50 meters averaged about five times as abundant in June as in winter, but then declined again by September to about the same numbers as in winter. At 200 meters, however, the increase (though at about the same rate) did not culminate until September or perhaps later. It is not clear from the available data, whether there is any definite seasonal alteration in the deeper levels, because the number of tows was not large enough for the ostensible differences between monthly averages to be significant, when station to station variations in abundance are so great.

2. Eudoxids. Eudoxids in the upper 50 meters were about 50 times as numerous in June as in winter, a rate of increase almost ten times as great as for the colonies. They then decreased by September to about $^1/_6$ the June strength, though still about 5 times as abundant then as in winter. And some trace of this same fluctuation is apparent as deep as 200 meters (see Tables 15, 16).

## Breeding Season and Depth.

The only previous information as to the seasonal occurrence of the eudoxids of *A. tetragona* in the Mediterranean is that the studies on which LEUCKART's (1853), VOGT's (1854), GEGENBAUR's (1854), and KEFERSTEIN and EHLERS' (1861) accounts were based were all carried out during the colder part of the year between October and May; and that MOSER's (1917) and LELOUP's (1933) records are for April, May, June, and September.

The capture by the "Thor" of a scattering of eudoxids in January and February is additional evidence that some reproduction does take place in winter. But the fact that the eudoxids were many times as abundant in June (above; LELOUP's two big catches were in May and September), but then decreased so markedly to September (above) shows that the spring is the chief breeding season.

The very definite concentration of eudoxids and of free gonophores (see list, p. 23) in the upper strata is equally conclusive evidence that reproduction in a significant amount is confined to the upper 100 meters at most, and very likely to the upper 50 meters.

## Abundance.

*A. tetragona* is not only one of the most regularly occurring siphonophores in the Mediterranean as far east on Long. 20° E., but also one of the more abundant in the western basin, the mean (corrected) at the level of maximum abundance at stations where it occurred, being approximately as shown in Table 16.

Table 16.

| Western basin | Colonies | Eudoxids |
|---|---|---|
| Winter | 31 per hour = 1 per 180 cu. meters | 5 per hour = 1 per 1100 cu. meters |
| Late June | 255 per hour = 1 per 21 cu. meters | 266 per hour = 1 per 20 cu. meters |
| Late August | 220 per hour = 1 per 25 cu. meters | 45 per hour = 1 per 152 cu. meters |

On the average, it is thus about $^1/_4$ abundant as *C. appendiculata.* Maximum catches were as shown in Table 17.

Table 17.

| Western basin | Colonies | Eudoxids |
|---|---|---|
| Winter | 470 per hour = 1 per 11 cu. meters | 100 per hour = 1 per 55 cu. meters |
| Late June | 1012 per hour = 1 per 5 cu. meters | 1486 per hour = 1 per 3.7 cu. meters |
| Late August | 2584 per hour = 1 per 2 cu. meters | 23,664 per hour = 1 per 0.2 cu. meters |

The Eastern basin stations are omitted from the calculations of absolute abundance, because *tetragona* was taken at so few stations there, and in such varying numbers.

## **BASSIA BASSENSIS** Quoy and Gaimard (p. 26).

Figs. 65, 66.

### Horizontal Distribution.

This species has now been taken often enough, and at widely scattered localities, to show that it is generally distributed through the tropical and sub-tropical belts of the oceans, Pacific, Indian, and Atlantic. First described from the Straits of Gibraltar, it has been taken quite regularly outside the latter on the Prince of Monaco's cruises (Leloup, 1933). But the only previous records for it within the Mediterranean were Alboran Sea (Leloup, 1933), Villefranche (Leloup, 1935), Naples, Ragusa, and the Adriatic (Moser, 1917). The results of the "Thor" hauls again show it at most of the stations just outside the Straits of Gibraltar. Only an occasional specimen was caught in the western basin (chiefly along the path of the inflowing Atlantic current) winter or summer (Fig. 65). In the eastern basin, however, it was represented by a few specimens at almost every station on the summer cruise—including the Aegean Sea—and was taken twice in abundance (north of Nicaria and within the Gulf of Aegina). On the winter cruise it was taken at two stations east of Sicily in the Ionian Sea, though not at the five other stations to the northward in the Adriatic and Gulf of Taranto, or at one in the Gulf of Aegina.

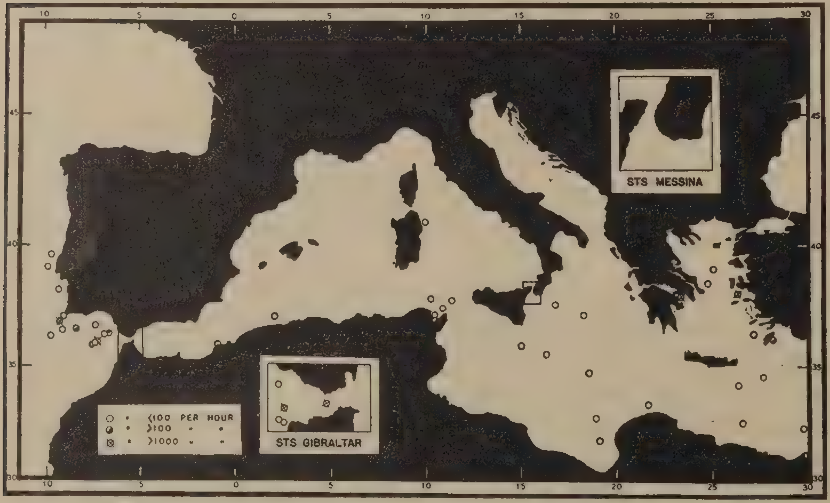

Fig. 65. "Thor" captures of colonies of *Bassia bassensis.*

Thus, it appears that while *B. bassensis* is something of a rarity in the western basin and perhaps only an immigrant there via the Straits from the Atlantic (where it is strongly represented), it is so widespread an inhabitant of the eastern basin (at least in summer), occasionally in abundance, as to suggest that the stock there is locally maintained. And this is corroborated by the captures of eudoxids[1] (Fig. 66) which were found in large numbers at 3 stations in the Atlantic (maximum, 16828 per hour, corrected), at one station in the Straits of Gibraltar (4776 per hour corrected), and at two stations in the eastern basin (maximum, 3408 per hour), but of which the maximum catch in any haul in the western basin was only 5 (20 per hour).

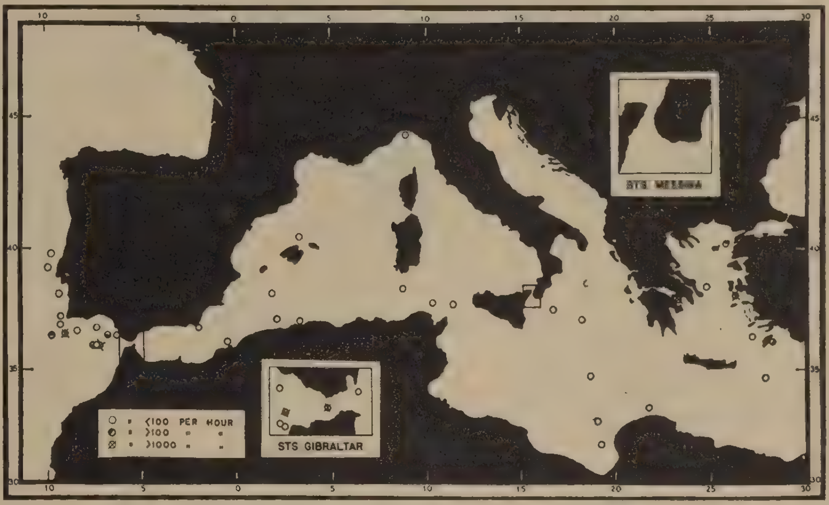

Fig. 66. "Thor" captures of eudoxids of *Bassia bassensis*.

The known distribution of *Bassia*, and (in particular) the fact that "the species is apparently unable to penetrate into the barrier reef lagoon [Great Barrier reef, Australia] during the period of lowered salinity" (Russell and Colman, 1935, p. 261) indicate that salinities considerably higher than 35 $^0/_{00}$ are most favorable for it.

## Vertical Distribution.

Table 18. "Meteor" catches, per 200 meters of towing at stations where there were tows at several levels, calculated from Leloup and Hentschel's (1935) tables.

| Depth | Total meters hauled at stations where taken | Total catch[1] | | Average catch per[1] 200 meters of hauling | |
|---|---|---|---|---|---|
| | | Colonies | Eudoxids | Colonies | Eudoxids |
| 0— 50 | 850 | 28 | 32 | 6.6 | 7.6 |
| 50— 100 | 1850 | 17 | 23 | 1.8 | 2.4 |
| 100— 200 | 400 | 3 | 3 | 1.5 | 1.5 |
| 200— 400 | 2000 | 1 | 3 | 0.1 | 0.3 |
| 400— 600 | 2000 | 2 | 0 | 0.2 | 0 |
| 600— 800 | 1900 | 0 | 0 | 0 | 0 |
| 800—1000 | 1800 | 1 | 0 | 0.1 | 0 |

[1] "Colonies" in this table includes both complete colonies and detached superior nectophores; "eudoxids" includes both the complete eudoxids and loose bracts.

It has long been known that *Bassia* frequently appears in abundance at the surface. And while it has also been brought back, repeatedly, in open hauls sent down to great depths, there is no evidence that any significant number have ever been actually taken more than 200 meters or so below the surface. Thus, the 70 odd colonies (or parts of colonies) recorded by Browne (1926) from the Indian Ocean were all taken in hauls which did not reach below 180 meters, though many other hauls were also made at greater depths, yielding other siphonophores. Analysis of the "Meteor" catches in closing nets (Table 18) shows the species as decidedly more regular in its occurrence above 100 meters than below, with only odd examples downward, though one was taken as deep as 800 meters.

The catches per hour (corrected for contamination) at the 5 "Thor" stations in the Mediterranean

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[1] Leloup (1935) has subsequently recorded one bract from Villefranche.

(all in the eastern basin) and the 6 "Thor" stations in the Atlantic, where as many as 10 nectophores or eudoxids were taken, and where both shoal and deep hauls were made are as follows (Table 19):—

Table 19.

Mediterranean.

| Winter:— | St. 10 | | St. 11 | |
|---|---|---|---|---|
| | Colonies | Eudoxids | Colonies | Eudoxids |
| 16 meters | 13 | 28 | 15 | 21 |
| 43 — | 1 | 0 | 0 | 0 |
| 200 — | — | — | 0 | 0 |
| 400 — | 3 | 2 | — | — |
| 666 — | — | — | 0 | 0 |

| Summer:— | St. 160 | | St. 163 | | St. 183 | |
|---|---|---|---|---|---|---|
| | Colonies | Eudoxids | Colonies | Eudoxids | Colonies | Eudoxids |
| 16 meters | 174 | 152 | 2256 | 2348 | — | — |
| 43 — | — | — | — | — | 3604 | 3408 |
| 200 — | 0 | 0 | 0 | 0 | 0 | 0 |
| 400 — | — | — | — | — | — | — |
| 666 — | 0 | 0 | 0 | 0 | — | — |

Atlantic.

| Winter:— | St. 65 | | St. 71 | | St. 231 | |
|---|---|---|---|---|---|---|
| | Colonies | Eudoxids | Colonies | Eudoxids | Colonies | Eudoxids |
| 16 meters | 8 | 0 | 4 | 42 | 0 | 0 |
| 43 — | 17 | 14 | 48 | 344 | 0 | 0 |
| 200 — | 0 | 0 | 36 | 274 | 5 | 14 |
| 400 — | 0 | 0 | 0 | 0 | 0 | 0 |
| 666 — | — | — | — | — | — | — |

| Summer:— | St. 89 | | St. 95 | | St. 231 | |
|---|---|---|---|---|---|---|
| | Colonies | Eudoxids | Colonies | Eudoxids | Colonies | Eudoxids |
| 16 meters | — | — | 3232 | 1828 | 1594 | 3138 |
| 43 — | 0 | 0 | 1480 | 2331 | — | — |
| 200 — | 21 | 44 | 0 | 0 | 0 | 0 |
| 400 — | — | — | — | — | — | — |
| 666 — | 73 | 56 | — | — | — | — |
| 800 — | — | — | — | — | 0 | 0 |

It is evident from the foregoing that in the Mediterranean, *Bassia* was even more definitely concentrated and (apparently for the most part, confined) to the upper 50 meters than the "Meteor" found it, with most of the stock living close to the surface, whether summer or winter. This was equally the case in the Atlantic, at the summer stations. In winter, however, it seems to have been roughly as abundant down to 200 meters there, as at the surface, though apparently none were living deeper than that.

The only apparent explanation in hydrology for this regional and seasonal difference in the depth of its lower boundary, is that the vertical stability of the upper 200 meters is considerably higher in the Atlantic in summer than in winter and was considerably higher in winter in the Mediterranean than in the Atlantic (Fig. 67) which would tend more to favor dispersal of colonies, downward in the Atlantic in winter than in summer and more in the Atlantic in winter than in the Mediterranean.

### Seasonal Changes in Abundance.

No decided seasonal fluctuation in abundance was recorded in the sparse population of the western basin, except perhaps just inside the Straits of Gibraltar, where shallow tows (43 meters) caught 3440 colonies and 4776 nectophores per hour in June (St. 98) but where a 600 meter haul yielded none at all in February (St. 61). In the Atlantic, however, and also in the eastern basin, where the species is both abundant and widespread (p. 93), colonies and eudoxids were much more numerous in summer than in winter, average catches being as follows (Table 20), for the upper 50 meters where the great majority of the stock is concentrated.

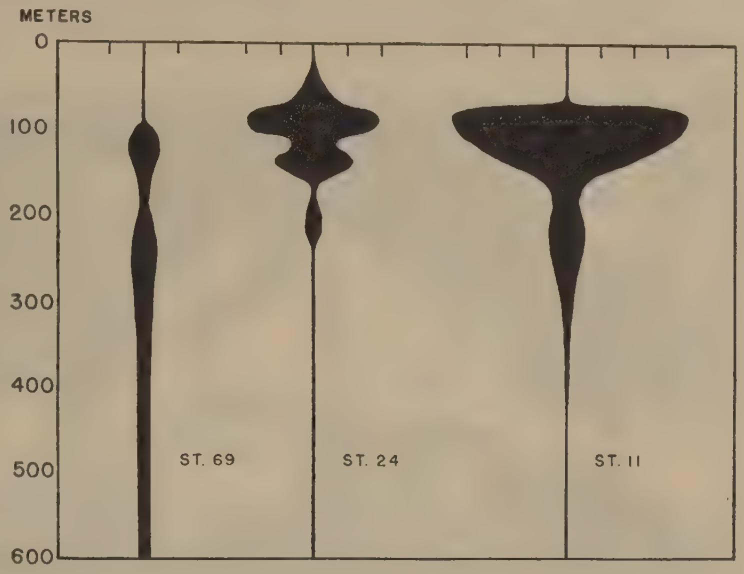

Fig. 67. Relative vertical stability, calculated according to Sandström (1919, p. 232) for 25 meter intervals, at winter stations in the Bay of Cadiz (St. 69) in February, and in the western (St. 24), and eastern basins (St. 11), December—January. Each division on the horizontal scale represents 0.1 unit of density [(sp. gr. —1) 1000] at the temperature *in situ*.

### Breeding Season and Abundance.

The captures of eudoxids on all the cruises is evidence of a certain amount of reproduction, the year round. But the fact that the eudoxids and colonies were much more abundant in June and later summer than in winter, both in the Atlantic and in the eastern basin (i. e., in regions where any considerable reproduction is indicated at any season) show that *Bassia* breeds the most actively from spring into summer. Some measure of the rate at which additions are made to the population at this time of year is given by the catches, winter as compared with summer. In the eastern basin, the indicated increase was about 67-fold for the colonies and 27-fold for the eudoxids between the February and August cruises (Table 19)[1]. In the Atlantic, it was about 457-fold for the colonies, 67-fold for the eudoxids (Table 19). And the fact that the largest catches of all, both of colonies, and of eudoxids, were made in the Atlantic on September 9, 1910 is an indication that the vernal breeding season does not reach its peak until mid-summer or perhaps even later. Conversely, the corresponding shrinkage in the strength of the population during the autumn gives at least a rough measure of the rate at which the death rate dominates over the replacement rate at that season.

Table 20.

| | No. of hauls at stations where taken | Extreme catches per hour | Mean No. of colonies per hour | Extreme catches per hour | Mean No. of eudoxids per hour |
|---|---|---|---|---|---|
| Atlantic:— Winter.......... | 10 | 0— 48 | 8 | 0— 344 | 40 |
| Summer ....... | 11 | 0—30492 | 3657 | 0—16828 | 2704 |
| Eastern basin:— Winter ... | 4 | 0— 15 | 7 | 0— 28 | 17 |
| Summer . . | 13 | 0— 3604 | 470 | 0— 3408 | 457 |

The maximum catch was at the rates of 30492 colonies, and 16828 endoxids, per hour, or 27442 and 153452 per 5000 cubic meters respectively.

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[1] Assuming that winter data for 1908—1909 can justly be combined with summer data for 1910.

## CERATOCYMBA SAGITTATA Quoy and Gaimard (p. 28).

Fig. 68.

### Horizontal Distribution.

This species has been found in the warm regions of the North and South Atlantic (Moser, 1925; Leloup, 1933, 1934; Leloup and Hentschel, 1935), the Eastern Tropical Pacific (Bigelow, 1911 b), the Indian Ocean (Browne, 1926), and the Malayan region (Lens and Van Riemsdijk, 1908). Despite the fact that it was originally described by Quoy and Gaimard (1827) from the Straits of Gibraltar (the eudoxids) and was taken by the expeditions of the Prince of Monaco at two stations in the Bay of Cadiz, it had never been taken within the Mediterranean before the time of the "Thor" cruises. The latter again had it (one colony) in the Straits of Gibraltar and at 11 stations in the Bay of Cadiz, but at only one station in the Mediterranean (Alboran Sea, 1 eudoxid) (Fig. 68).

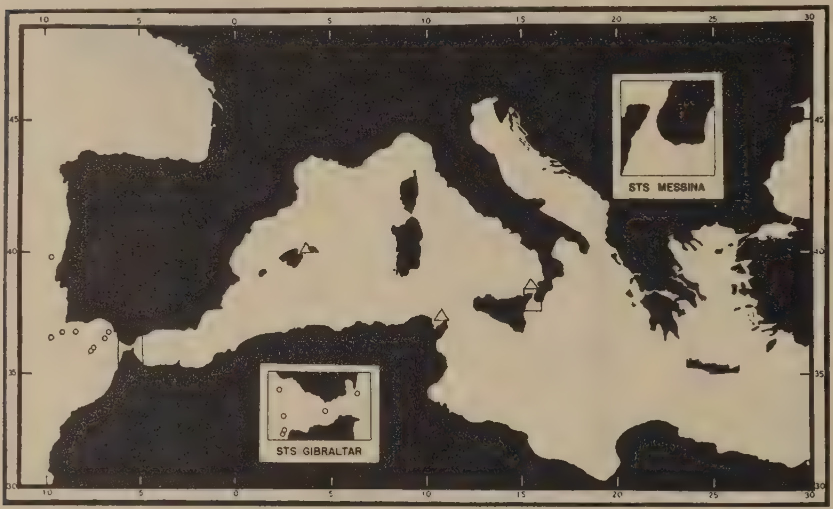

Fig. 68. "Thor" captures of *Ceratocymba sagittata* (circles) and *Suculeolaria quadrivalvis* (triangles).

As specimens were taken in the bay of Cadiz in hauls as shoal as 43 meters, there is no mechanical barrier to its entrance through the straits. Present indications thus are that this is a warm water species, which, if it drifts within the Mediterranean, shortly perishes there without successful colonization.

### Vertical Distribution.

Captures of this species (both nectophores and eudoxids), in hauls from 16 and 43 meters show that at least some were living in the surface waters: this accords with previous data, which include catches both of colonies and of eudoxids, not only right at the surface, but at various depths less than 100 meters (Quoy and Gaimard, 1827; Moser, 1925; Bigelow, 1918). The "Thor" hauls at 200, 400, and 666 meters also yielded a few, but the numbers were in every case so small that no conclusions can be drawn as to the levels in the water at which they were picked up by the nets. And this also applies to the considerable number of open hauls, from shoal depths down to considerable depths, from which it has been reported by other authors. How deep its normal range may extend thus remains doubtful.

### Breeding Season and Abundance.

Captures of eudoxids in the Bay of Cadiz in February as well as in June, but in much the larger numbers and with free gonophores in the latter month, shows that while the breeding season of this species is not definitely localized, reproduction is more active in summer than in winter.

The fact that the maximum catches were at the rate of only 6 colonies and 8 eudoxids per hour makes it doubtful whether this species is ever abundant, either in the Mediterranean or in the neighboring parts of the Atlantic.

## SULCULEOLARIA QUADRIDENTATA Quoy and Gaimard (p. 31).

Fig. 69.

### Horizontal Distribution.

Previous records which can be definitely attributed to *S. quadridentata*, as distinguished from *S. quadrivalis* (p. 31) though few, have shown it to be widespread in the Eastern Tropical Pacific (Bigelow, 1911 b, 1931), in the region of the Great Barrier Reef, Australia (Totton, 1932), in the Indian Ocean (Browne, 1926), in the South Atlantic (Moser, 1925; Leloup, 1932), in the vicinity of the Canaries and Azores (Leloup, 1933), and in the western basin of the Mediterranean at Naples and Villefranche (Keferstein and Ehlers, 1861; Lochman, 1914; Bigelow, 1918; Leloup, 1933).

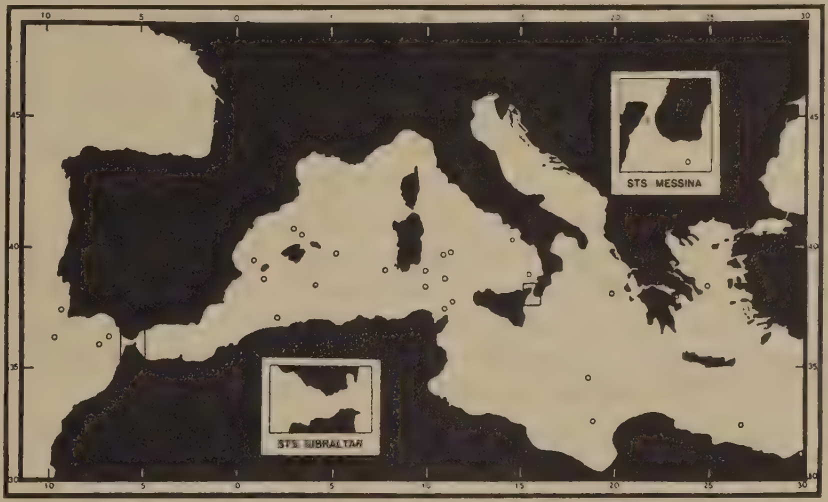

Fig. 69. "Thor" captures of *Sulculeolaria quadridentata.*

The "Thor" caught scattering specimens at 30 stations along her route (Fig. 69), winter as well as summer. Those taken on the winter cruise were all outside the Straits of Gibraltar in the Bay of Cadiz. Those on the summer cruise were scattered throughout the Mediterranean, except for the Levant, suggesting possible immigration from the Atlantic.

### Vertical Distribution.

The catches of *quadridentata* were never large enough to permit a detailed analysis of the vertical distribution. But a casual inspection of the list of material suggests that it is a surface form, for 70 $^0/_0$ of the tows that took it were at 16 and at 43 meters, which accords with previous information. Among the 11 hauls from the layers as deep as 200 meters or deeper which yielded it, all but 3 were at stations where it was also caught in the shoal tows: the specimens may, therefore, have been picked up as the net passed through the upper layers. And while it failed in the shoal tows at 2 stations of this group, the specimens brought up by the deep hauls may also have come from small depths, for the surface population was so sparse that one net may well have missed it and another have picked up an occasional individual. This also applies to the remaining station where no shoal tow was made.

### Abundance.

The largest catch was at the rate of 32 superior nectophores per hour (28 per 5000 cubic meters).

## SULCULEOLARIA QUADRIVALVIS Blainville (p. 32).

Fig. 68.

### Horizontal Distribution.

While there are many published records under this name, particularly in the Mediterranean, it has often been confused with *S. quadridentata*. Records that undoubtedly refer to *quadrivalvis* prove it widespread in the Eastern Tropical Pacific (Bigelow, 1911 b, 1931), in the South Pacific (Leloup, 1932), the Philippines (Bigelow, 1919), the Malayan region (Lens and Van Riemsdijk, 1908), off the Great Barrier Reef, Australia (Totton, 1932; Russell and Colman, 1935); and in the Indian Ocean (Browne, 1926). There are positive records of it in the Mediterranean at Nice (Vogt, 1854; Leuckart, 1854) and at Messina (Gegenbaur, 1854).

The "Thor" only took three specimens, one in the southern part of the Pantellarian Channel (St. 137), 1 northwards from the Straits of Messina in the Tyrrhenian Sea (St. 192), and 1 in the vicinity of the Balearic Islands (St. 207) — all in tows from 43 meters or shoaler (Fig. 68).

## **GALETTA AUSTRALIS** Quoy and Gaimard (p. 35).

Fig. 70.

### Horizontal Distribution.

This wide-ranging species is known from many localities in the Indian Ocean (Quoy and Gaimard, 1833; Huxley, 1859; Browne, 1926), in the Malayan region (Lens and Van Riemsdijk, 1908), in Philippine waters (Bigelow, 1919), in the South Pacific (Leloup, 1932), in the Eastern Tropical Pacific (Bigelow, 1911 b), in the South Atlantic (Moser, 1925; Leloup, 1932, 1934), and in the North Atlantic as far north as the Norwegian coast and Spitzbergen (Sars, 1846; Bigelow, 1918; Candeias, 1929; Leloup, 1932, 1934; Romer, 1902). Previous records in the Mediterranean are:—

Naples — Chun (1885), Schneider (1898);
Messina — Gegenbaur (1854), Sars (1857), Keferstein and Ehlers (1861);
Adriatic. Southern Deep — Moser (1917).

Specimens referable to *G. australis* were taken at so many stations along the "Thor's" route (Fig. 70), on all the cruises (as well as at many of the supplementary stations) as to prove it a regular inhabitant both of the eastern and western basins, as well as of the neighboring parts of the Atlantic, though it was not an abundant member of the siphonophore population anywhere.

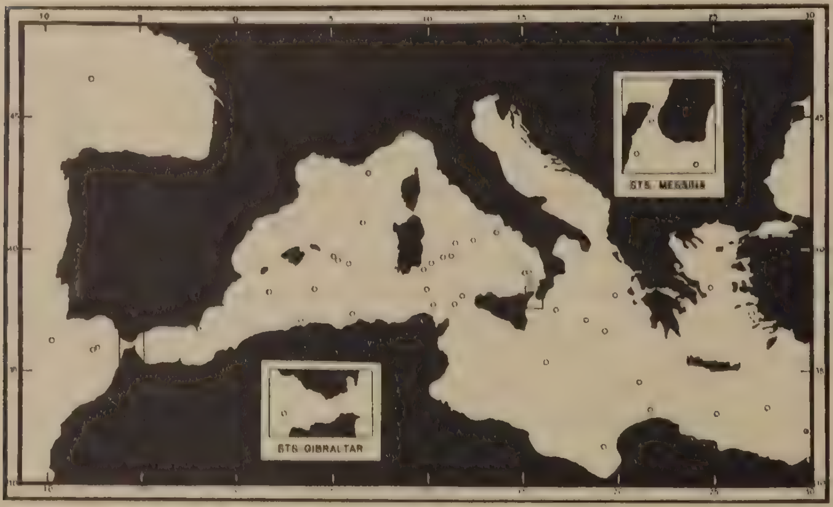

Fig. 70. "Thor" captures of *Galetta australis*.

### Vertical Distribution.

Sixty percent of the "Thor" tows which took *G. australis* were shallow (16 and 43 meters). Fourteen of the 24 hauls from layers as deep as 200 meters that yielded it, were at stations where its presence at small depths was proved by its capture in tows from 16—43 meters. Hence, the deep nets may have picked up their catches on the way up or down (bringing the possible percentage of shoal catches up to 83 %). And the numbers concerned were so small that this is equally possible for the catches of the remaining 10 deep tows, where corresponding shallow tows may simply have chanced to miss it. The fact that in most cases the deep tows were of longer duration than the shoal makes this the more likely.

Though the catches were not large enough to permit any further analysis, the foregoing is enough to show that *G. australis* may be described as distinctly a surface form in the Mediterranean. This seems to be true of it throughout its range, for wherever it has been taken in any numbers, or with any frequency, so large a proportion of the catches have been at the surface as to make it probable that specimens brought in by deeper hauls — as has often happened — were picked up by the nets at no great depth.

The Atlantic catches — 2 nectophores at 16 meters; 1 at 43 meters; 2 at 200 meters; 2 at 1600 meters — were too scattered and the specimens too few in number to be significant in this respect.

The maximum catch (Mediterranean) was at the rate of 220 superior nectophores per hour (198 per 5000 cubic meters).

## **MUGGIAEA ATLANTICA** Cunningham (p. 39).

Fig. 71.

### Horizontal Distribution.

Seen first almost 50 years ago at the Canary Islands by Haeckel (1888b, p. 137, *Muggiaea pyramidalis*), this small diphyid is now known to be common in the general region of the English Channel, Irish Sea, and off the south and west coasts of Ireland (Cunningham, 1892; Blès, 1892; Gough 1905; Russell 1934). Recently, it has been caught in the South Atlantic along the west coast of Africa by the "Meteor". It has also been reported from the Pacific off the east coast of Japan (Moser, 1925), in Monterey Bay (Bigelow and Leslie, 1930), and along the route of the "Albatross" in the Eastern Tropical Pacific (Bigelow, 1911b). Strangely enough, it was not found by the "Research" in the Bay of Biscay (Bigelow, 1911), or in the material collected by the Prince of Monaco in the vicinity of Gibraltar, or within the Mediterranean (Leloup, 1933). The "Thor", however, took it at two stations along the coast of Portugal, at several just outside the Straits of Gibraltar in the Bay of Cadiz, in the Straits and in the Alboran Sea, and along the north coast of Africa as far as Tunis — in the swifter part of the inflowing Atlantic current. Aside from these, there are but three records for it in the Mediterranean — one in the eastern part of the Sidra Sea, one South east of Crete, and one (identification doubtful) in the Ligurian Sea (Fig. 71).

In its horizontal distribution, *M. atlantica* stands alone among the siphonophores of the "Thor" expedition, for most of the Mediterranean localities of record are concentrated, not only in the southern side, but within 60 miles of the 200 meter line at farthest. And this was also the case in the Bay of Cadiz. Especially striking was its absence at stations out in the Bay, during the month (June) when large catches were made close in to the coast only a few miles distant (Fig. 71). Since all previous records of it have likewise been near the coast, whether in the English Channel, off Ireland (Cunningham, 1892; Gough, 1905; Russell, 1933), off the west coast of Central and South America (Bigelow, 1911b), off Japan (Bigelow, 1913), or off the west and southwest coasts of Africa (Leloup, 1934),

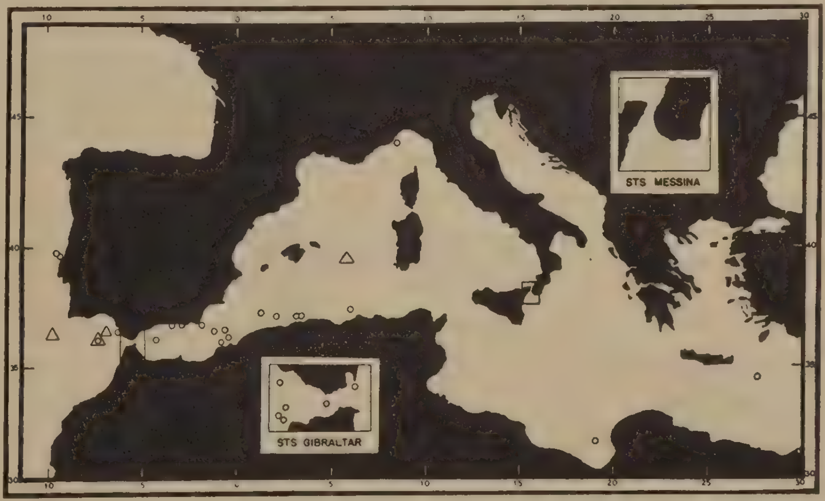

Fig. 71. "Thor" captures of *Muggiaea atlantica* (circles) and *Diphyes dispar* (triangles).

it seems that this is definitely a neritic species; a characterization that may also prove to apply to *M. Kochii* (Russell, 1934), to *Diphyes chamissonis*, and to *Lensia subtiloides* (Russell and Colman 1935, p. 271).

The frequency of its occurrence in the southern side of the western basin of the Mediterranean, contrasted with the sparseness of occurrence elsewhere, suggests that immigation from rich concentrations in the Bay of Cadiz is an important factor in maintaining the stock within the Mediterranean. The fact that the richest June catches in the Bay of Cadiz were all made within 43 meters of the surface, well within the sweep of the inflowing current (assuming the latter to have been active at the time), is in line with this. So, too, is the improbability that any species at home as far north as the English Channel, should find a habitat definitely more favorable on the southern side of the Mediterranean than in the northern. On the other hand, there is no evidence that the development of a rich population in the Bay of Cadiz in June was either accompanied or followed by any general expansion of its range within the western basin of the Mediterranean. Nor can its capture at two stations in the eastern basin in summer, but not in winter, be safely so interpreted, because the nets may simply have missed it there in the cold season when it was very scarce everywhere. Neither is the numerical occurrence within the Mediterranean suggestive of recent mass immigration from the Atlantic, for one catch in the eastern basin far from the point of entrance was as large as any in the western basin and almost as rich as the June population in the Bay of Cadiz.

It would, in short, be impossible to determine without following the species in the Mediterranean through several years, whether it is in fact a reliable indicator there of Atlantic water, or the relative importance for it of immigration as compared with local centers of reproduction, in maintaining the Mediterranean population.

### Vertical Distribution.

The many records of this species, from the vicinity of Plymouth England[1], are from shoal water (Blès, 1892; Cunningham, 1892; Garstang, 1894; Gough 1905; Russell, 1935). As it was also represented abundantly at the surface, and in open hauls down to 50—0 meters, off Monterey (Bigelow and Leslie, 1930), and as the deepest positive record for it is only 50—100 meters (Leloup and Hentschel, 1935) it seems likely that specimens taken in open hauls from 550—0 meters in the Eastern Tropical Pacific (Bigelow, 1911 b) were also caught at small depths.

Tabulation of average catches (corrected) at "Thor" stations where the species was taken, and where deep hauls were made as well as shoal, similarly shows unmistakable preponderance in the uppermost stratum sampled (Table 21):—

Table 21.

| Depth meters | Atlantic | | | Mediterranean | | |
|---|---|---|---|---|---|---|
| | No. of hauls | Extreme catches per hour corrected | Mean catch per hour corrected | No. of hauls | Extreme catches per hour corrected | Mean catch per hour corrected |
| 16 + 30 + 25 + 43 + 66 | 10 | 0—356 | 25 | 16 | 0—274 | 47 |
| 200 | 4 | 0— 37 | 9 | 11 | 0—292 | 33 |
| 333 + 400 | 3 | 0— 3 | 1 | 4 | 0— 2 | < 1 |
| 800 + 1066 + 1333 | 2 | 0—<1 | 1 | 7 | 0— 9 | 1 |

This also appears from the fact that all catches at the rate of more than 350 per hour were from 43 meters, or shoaler[2].

Mean catches suggest that the lower limit of its occurrence in significant numbers is considerably closer to the surface in the Atlantic (about 100 meters) than in the Mediterranean (deeper than 200 meters). Actually, this calculated difference results from the fact that a catch at the rate of 292 per hour was made by a 200 meter haul at one Mediterranean station (St. 147), whereas in the Atlantic, 43 meters was the greatest depth where the catch was 200 colonies per hour (St. 94, 1000 per hour, corrected). The differences may thus be merely an evidence of sporadic swarming at one level or another.

---

[1] According to Cunningham (1892) the siphonophore reported from Plymouth by Bourne (1890) as *M. Kochii* was actually *M. atlantica*. But Russell (1934) has now found that both species occur there.

[2] St. 93, 33 meters, 356 per hour; St. 94, 43 meters, 1000 per hour; St. 98, 43 meters, 2808 per hour; St. 221, 25 meters, 484 per hour.

### Seasonal Variation, Breeding Season and Abundance.

No eudoxids were found. But an increase in the maximum numbers of nectophores per haul, from only 36 per hour in February to upwards of 1000 per hour in June in the Bay of Cadiz, and from 34 per hour in February, to 200—2804 in June, and 584 in September in the western basin of the Mediterranean, points to a wave of reproductive activity in spring and early summer, followed by a rapid death rate in late autumn and early winter. This type of reproductive cycle is common among inshore planktonic animals.

The maximal catch for February was at the rate of about 34 per hour, or 1 specimen per about 160 cubic meters of water, whereas in June (in the Straits) it was at the rate of 2808 per hour, or 1 specimen per 2 cubic meters. At its centers of maximum production, *atlantica* may thus be one of the more abundant siphonophores.

## **DIPHYES DISPAR** Chamisso and Eysenhardt (p. 40).

Fig. 71.

### Horizontal Distribution.

*D. dispar* has often been recorded from the warm zones of all oceans, including the Straits of Gibraltar where it was first described by Quoy and Gaimard (1827). But the only previous record from the Mediterranean is by Verany (1846) who mentions it in a list of the fauna of Genoa and Nice, under the name of *Diphyes Bory*. While this name is a synonym of *D. dispar*, it is not certain whether this was actually the diphyid referred to.

The "Thor" took one colony in the center of the Balearic Sea. But as this is only the second Mediterranean record in the literature of this relatively large diphyid, it seems unlikely that it is more than a stray migrant inside the straits. The "Thor" also took it at several stations in the Bay of Cadiz, but it apparently does not extend much to the north of this as it was not found along the coasts of Spain and Portugal nor on the traverse in the offing of the Bay of Biscay (Fig. 71) where the "Research" also failed to find it (Bigelow, 1911 a).

## **CHELOPHYES APPENDICULATA** Eschscholtz (p. 41).

Fig. 72.

### Horizontal Distribution.

*C. appendiculata* is found in all oceans (see Moser, 1925). It is also the commonest of all siphonophores; Chun (1887, p. 12) writes of it, at Naples, that "Kaum ein pelagisches Thier ist gemeiner". It has often been taken in the Mediterranean at the following localities:—

Mentone — Pagenstecher (1869);
Naples — O. G. Costa (1836), Spagnolini (1868, 1870), Pavesi (1869...), P. E. Müller (1871), Bedot (1882), Chun (1887), Schneider (1898), Neppi (1921), Moser (1923);
Capri — Lo Bianco (1903);
Messina — Kölliker (1853), Gegenbaur (1854), Keferstein and Ehlers (1861), Cialona (1901);
Nice — Leuckart (1853, 1854), Vogt (1854);
Villefranche — Lochman (1914), Moser (1923), Leloup (1935);

Adriatic, off Skardo-Isto — Moser (1917, 1 specimen);
Western Basin — Leloup (1933).

*C. appendiculata* was generally distributed along the routes of the "Thor" throughout the basins of the Mediterranean, in the Aegean Sea, and even in the landlocked waters of the Gulf of Corinth. But as it failed at all of the stations in the Sea of Marmora, in the Dardenelles, and within the entrance of the Black Sea, it seems reasonably certain that it is not carried inward along this route by the deep indrafts of saline Mediterranean water, in numbers large enough to maintain a significant population (Fig. 72).

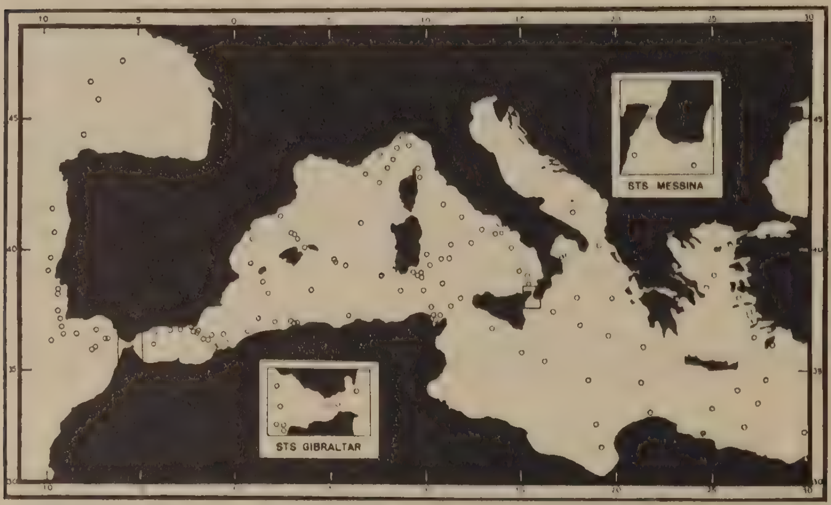

Fig. 72. "Thor" captures of *Chelophyes appendiculata*.

In summer, *appendiculata* was not only generally present everywhere along the "Thor"'s route (85 %) of the stations with appropriate tows) but the rich catches (> 900 nectophores per hour) were widely scattered in both basins, close in to land, as well as out to sea. The whole southern part of the eastern basin seems, however, to have been sparsely populated, for while *appendiculata* was recorded at every station there, the maximum abundance, south of latitude 35°, was only 220 nectophores per hour's tow (corrected), contrasted with frequent catches of more than 1000 in the western basin, north to south. *Appendiculata* seems also to be scarce in the Aegean Sea, absent altogether, as just noted from the approaches to the Black Sea.

In winter, while equally widespread (88 % of the stations with appropriate tows), it was taken in significantly smaller numbers (p. 41) and with no obvious correlation with locality.

In the case of a species such as this, which is often concentrated near the surface at the season of chief abundance (p. 103), movement inward, through the Straits of Gibraltar, with the upper current may be expected to dominate over movements outward, with the deep outflowing one. And the situation existing at the times of the February and June cruises show that the Bay of Cadiz often supports a population large enough, appreciably to affect the stock just within the Straits, if actually caught up by the inflow, for the average numbers were considerably greater outside the Straits than inside, as follows (Table 22). But in September, such small regional contrast as did exist was the reverse. And in any case, the records of regional occurrence within the Mediterranean set forth above, argue that distribution and local abundance there are not significantly affected by immigration from the Atlantic via the Straits of Gibraltar, but that the stock is self contained, and maintained by local reproduction.

Table 22. Catches per hour (corrected) at 16—43 meters at stations where the species was taken inside and outside the Straits of Gibraltar, in different months.

| Month | Average inside | Extreme catches inside | No. St. inside | Average outside | Extreme catches outside | No. St. outside |
|---|---|---|---|---|---|---|
| Feb. | 40 | 4—130 | 4 | 230 | 0— 776 | 5 |
| June | 35 | 0— 60 | 4 | 3272 | 10—11170 | 5 |
| Sept. | 301 | 0—904 | 3 | 100 | 18— 182 | 2 |

## Vertical Distribution.

The hauls in which *C. appendiculata* has been taken in the past, have seldom been of a type to give definite information as to the relative abundance of this species at different depths. Exceptions are the few catches made with closing nets in the Mediterranean by **Chun** (1887); in the Atlantic by the Plankton Expedition (**Chun**,1897) and by the Prince of Monaco (**Bedot**, 1904), in the Bay of Biscay by the "Research" (**Bigelow**, 1911 a), and in the North and South Atlantic by the "Meteor" (**Leloup**, 1934). These prove that its extreme range extends from the surface down to at least 1000—1300 meters. But the distribution of catches show (especially **Chun**'s Mediterranean data, and the "Research" data for the Bay of Biscay) that it is much the more abundant between the surface and 200 meters, than deeper. Off Naples, **Chun** found it most plentiful at 80—100 meters. Similarly, the "Meteor" catches per 200 meters of towing at stations where the species occurred, and where tows were made at several levels (**Leloup** and **Hentschel**, 1935) averaged about 4 7 colonies between the surface and 100 metres, but less than 1 at greater depths.

The "Thor" data for the Atlantic again yield the picture of a species much the most abundant in the upper 200 meters, with abrupt decrease in numbers, with increasing depth below that level (Table 23).

In the Mediterranean, however, the concentration in the upper 50 meters was more pronounced on the one hand, but on the other hand the lower level to comparative high abundance lay at least 200 meters deeper (i. e. at 400 meters) than in the Atlantic. And this regional difference, in the relative vertical distribution of this species is largely responsible for the corresponding difference for siphonophores as a whole, shown by the "Thor" catches for the Mediterranean, as contrasted with the Atlantic (p. 137).

Segregation of the Mediterranean catches, by months, shows the following seasonal distribution.

Summer. The relationship of the 200 meter catch (uncorrected) to the 16 meter or 43 meter

Table 23. Average catch at Atlantic stations where *Chelophyes* was taken, and where deep hauls were made as well as shallow.

| Depth Meters | No. of tows | Extreme catches per hour (corrected) | Average catch per hour (corrected) |
|---|---|---|---|
| 16 | 16 | 0— 796 | 196 |
| 43 | 12 | 0—3872 | 396 |
| 200 | 17 | 0— 344 | 138 |
| 400 | 8 | 0— 55 | 10 |
| 666 | 3 | 0— 37 | 23 |
| 800 | 2 | 0 | 0 |
| 1066 | 4 | 0 | 0 |

Table 24. Average catches of *Chelophyes appendiculata* per hour (corrected) at all Mediterranean stations, where the species was taken.

| Depth | Catch | Depth | Catch |
|---|---|---|---|
| 16 meters .......... | 439 | 666 meters .......... | 10 |
| 43 — .......... | 800 | 800 — .......... | 3 |
| 200 — .......... | 150 | Deeper than 1300 meters | < 1 |
| 400 — .......... | 158 | | |

Table 25.

| Station | 200 meter value | Station | 200 meter value |
|---|---|---|---|
| 99[1] | 23.3 | 125[2] | 0.07 |
| 106[3] | 3.0 | 126[2] | 0.20 |
| 107[1] | 0.52 | 129[2] | 0.05 |
| 108[1] | 0.17 | 131[2] | 0.06 |
| 112[2] | 1.01 | 132[2] | 0.95 |
| 115[2] | 0.03 | 133[2] | 0.07 |
| 116[2] | 0.04 | 134[2] | 0.53 |
| 118[2] | 0.22 | 138[2] | 0.04 |
| 123[2] | 0.10 | 139[2] | 0.60 |

[1] Shoalest tow, 43 meters.

[2] Calculated in relation to the 16 meter tow.

[3] Catch at 16 meters, 0; at 200 meters, 3.

Table 26.

| Station | Depth | No. of specimens actually caught | No. of specimens per hour (uncorrected) | No. of specimens per hour (corrected) |
|---|---|---|---|---|
| 99 | 43 | 5 | 20 | 20 |
| | 200 | 205 | 410 | 315 |
| 132 | 16 | 273 | 546 | 546 |
| | 200 | 374 | 748 | 560 |
| | 400 | 644 | 1288 | 877 |

catch, at June stations in the western basin, shows wide variation, considering the shoal catch as unity (Table 25).

This station to station variation, may be further illustrated by the catches (corrected) per hour at stations 99, and 132 (Table 26).

But the foregoing tabulations show that in only about $^{1}/_{5}$ of the cases was the catch of *appendiculata* as large at 200 meters as at 50—100 meters. The mean catches (corrected) per hour, at different levels, for this group of stations combined, similarly shows the population of the western basin as averaging more than ten times as abundant at 16 meters, or at 43 meters, as at 200 meters as follows (Table 27).

Table 27.

| Depth in meters | No. of hauls | Colonies per hour (uncorrected) | Colonies per hour (corrected) | Value relative to shoalest stratum |
|---|---|---|---|---|
| 16 | 4 | 1382 | 1220 | 1.00 |
| 43 | 9 | 1013 | 943 | .77 |
| 200 | 17 | 152 | 112 | .09 |

Table 28.

| Station | Value of 400 meter catch referred to 200 meter level (uncorrected) | Same, corrected |
|---|---|---|
| 129 | 0.93 | 0.17 |
| 132 | 1.72 | 1.57 |
| 133 | 1.00 | < 0.01 |

The one occasion when the 200 meter population was many times the stronger was at a station where the shoal population was decidedly sparse (St. 99, 43 meters, 17 nectophores per hour, corrected). Neither was *appendiculata* ever taken at 200 meters in anything approaching the abundance in which it often occurs near the surface.

Catches, however, averaged at about the same rate (if not corrected) at 400 meters as at 200, at 2 of the 3 stations where tows were made at both levels; much smaller if corrected (Table 28).

And corrected numbers per unit, for deep tows in the western basin, yield the following evidence that measurable numbers may rarely exist even as deep as 800 meters[1], though the deep catches were so small as to suggest that the population at depths greater than 400—500 meters was extremely sparse.

| | | |
|---|---|---|
| 666 meters: | St. 129 | < 1 |
| | St. 131 | 1 |
| | St. 138 | < 1 |
| 800 meters: | St. 106 | 11 |
| 1333 meters: | St. 115 | < 1 |

Table 29.

| Depth in meters | No. of hauls at stations where taken | Colonies per hour, (uncorrected) | Colonies per hour (corrected) | Value relative to shoalest stratum |
|---|---|---|---|---|
| 16 + 43 | 12 | 1169 | 1164 | 1.00 |
| 200 | 12 | 256 | 36 | .03 |

The following calculations (Table 29) for the summer (July—August) catches in the eastern basin, show the relative vertical distribution to have been essentially the same there, as in the western basin, as indeed, was to be expected.

And while 3 out of 12 available stations showed the 200 meter population from 1—3 times as great as the 16 or 43 meter population, here (as in the western basin) this happened only where the latter was relatively sparse[2].

Most of the summer catches made in the eastern basin in hauls from deeper than 200 meters were so small that contamination from the shoaler layers may have been entirely responsible[3]. In only two cases does application of the correction leave any residue:— namely, St. 187 and 189, 19 and 93 per hour respectively at 666 meters. Taken at face value, this suggests that the lower limit to the regular occurrence was somewhat more sharply defined and perhaps somewhat closer to the surface in the eastern basin than in the western.

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[1] Station 122: No shallow tow, 400 meter tow yielded 201 colonies, 800 meters, 34 colonies, but they may all have been taken near the surface for all that is known to the contrary.

[2] St. 181, 43 meters, 40 per hour; St. 187, 16 meters, 20 per hour; St. 189, 16 meters, 64 per hour.

[3] St. 156, 192, 400 meters; St. 143, 147, 156, 160, 666 meters; St. 186, 800 meters; St. 144, 1333 meters; St. 144, 160, 2666 meters.

Autumnal Change. Comparison of the late August—September data with the June data, for the western basin, gives some indication that an alteration in the relative vertical distribution begins during the late summer. Unfortunately, only one late summer station had tows at both 16 and 43 meters. In this one case (St. 204), the deeper of the two (43 meters) yielded 2728 *appendiculata* per hour, contrasted with only 1715 per hour at 16 meters. In one other case (St. 209), the relationship was similar between 16 meters (338 per unit) and 66 meters (987 per unit). So far as these go, they suggest that the zone of maximum abundance may have sunk somewhat since June, i. e. from close to the surface to perhaps the 40—70 meter level. And this is made the more likely by the fact that the disparity between the average populations of the upper 50 meters and of the 200 meter level, which was of the order of 10 to 1 in June (p. 103) was considerably less for the late August—September stations, as evidenced in Table 30.

Table 30. August—September.

| Depth | No. of hauls at stations where taken | Mean no. of colonies per hour uncorrected | Mean no. of colonies per hour corrected | Value relative to shoal tow |
|---|---|---|---|---|
| 16—43 | 7 | 1045 | 819 | 1.0 |
| 200 | 6 | 342 | 275 | 0.4 |

Table 31.

| Station | 200 meter value referred to shoal level | Station | 200 meter value referred to shoal level | |
|---|---|---|---|---|
| 195 | 0.62 | 204 | 0.05 | |
| 197 | 1.15 | 206 | 0.28 | |
| 199 | 4.26 | 209 | 1.76 | Mean = 1.35 |

Furthermore, the catch (corrected) was the larger in the 200 meter hauls at half of these late season stations as follows (Table 32), but at only about $^1/_5$ of the June stations.

In August—September, however, as in June, this preponderance at 200 meters occurred only at localities where the shoal catch was relatively small (St. 197, 16 meters — 73 per hour (corrected); St. 199, 16 meters — 130 per hour (corrected); St. 209, 16 meters — 338 per hour (corrected). And there is no evidence that seasonal enrichment of the 200 meter level (if it actually existed), extended any deeper, because the August—September catches in the western basin from greater depths were uniformly insignificant as follows:—

St. 210 — 400 meters .................... Catch per hour (corrected) — 63
- 199 — 666 — .................... — - — — < 1
- 194 — 800 — .................... — - — — < 1
- 208 — 1333 — .................... — - — — < 1
- 209 — 1333 — .................... — - — — < 1

Winter. In winter, the 200 meter catches in the western basin (whether corrected or uncorrected) averaged about as large as the 43 meter and half as large as the 16 meter catches, instead of only about $^1/_{10}$ as large as in early summer. The catch was, in fact, greatest in the 400 meter tow, at two of the four winter stations where hauls were made at that depth as well as shoal. And the fact that *appendiculata* seems to have been most plentiful at 600 meters at one of the five winter stations in the western basin, where it occurred and where deep hauls were made, at 1000 meters at another, suggests that this species may occasionally extend its range much deeper in winter than in summer. This is not a general rule since it seems to have been wholly confined to the uppermost 100 meters at two other winter stations of this group. Details as to the pertinent winter catches just mentioned, are summarized in the following tables 32 and 33.

Table 32. Comparison of 200 meter and 400 meter catches with shoal catches during the winter in the western basin.

| Station | Depth | Number per hour (corrected) | Relative value (shoalest tow being unity) | Station | Depth | Number per hour (corrected) | Relative value (shoalest tow being unity) |
|---|---|---|---|---|---|---|---|
| 24 | 16 | 32 | 1.0 | 31 | 43 | 152 | 1.0 |
| | 43 | 48 | 1.3 | | 133 | 70 | 0.46 |
| | 200 | 0 | 0.0 | | 400 | 107 | 0.7 |
| | 400 | 255 | 8.2 | 50 | 16 | 240 | 1.0 |
| 29 | 43 | 0 | ? | | 43 | 47 | 0.18 |
| | 133 | 19 | ? | | 200 | 0 | 0.0 |
| | 400 | 19 | ? | | 400 | 0 | 0.0 |

Table 33. Comparison of the shoal catches with catches from 600 meters and deeper during the winter in the western basin.

| Station | Depth | Number per towing hour (corrected | Relative value (shoalest being unity) | Station | Depth | Number per towing hour (corrected) | Relative value (shoalest being unity) |
|---|---|---|---|---|---|---|---|
| 35 | 16 | 0 | ? | 29 | 400 | 19 | ? |
| | 66 | 0 | ? | | 1100 | 22 | ? |
| | 133 | 3 | ? | 50 | 16 | 240 | 1.0 |
| | 200 | 52 | ? | | 43 | 47 | 0.18 |
| | 466 | 19 | ? | | 200 | 0 | 0.0 |
| | 666 | 174 | ? | | 400 | 0 | 0.0 |
| 31 | 43 | 152 | 1.0 | | 1066 | 0 | 0.0 |
| | 133 | 70 | 0.46 | 59 | 16 | 129 | 1.0 |
| | 400 | 107 | 0.7 | | 66 | 4 | 0.03 |
| | 933 | 22 | 0.14 | | 333 | 0 | 0.0 |
| 29 | 43 | 0 | ? | | 800 | 0 | 0.0 |
| | 133 | 19 | ? | | | | |

This tendency toward a seasonal shift in the center of population to a deeper level in winter than in summer, appears much more clearly in the eastern basin, where the following distribution of catches points to a definite reversal of concentration, from the shoal strata in the warm part of the year (p. 104), to the 400—600 meter zone in the cold (Table 34).

Table 34. Corrected catches per hour in winter, in the eastern basin.

| Depth | No. of tows at station where taken | Extreme catches (corrected) | Mean catches (corrected) |
|---|---|---|---|
| 16—43 | 9 | 0— 101 | 15 |
| 200 | 4 | 0— 22 | 6 |
| 400 | 1 | 570 | 570 |
| 666 | 4 | 8—1191 | 393 |

The great irregularity of distribution forbids a more definite statement. It is, however, interesting, in passing, that the larger of these deep catches rank favorably with the most productive summer catches from the shoal layers, the one from 400 meters (St. 10) being especially interesting because the shoaler tows at this station yielded only 28 per hour (corrected) at 16 meters, 2 per hour at 43 meters and none at all at 200 meters.

How much deeper, in the eastern basin, a significant population may have existed in winter is doubtful. One tow from 800 meters (St. 10) yielded none at all; one from 933 meters (St. 15) brought back 13 (corrected value, 9 per hour).

The foregoing may be summarized as follows:—

If the combination of summer conditions for 1910 with the winter conditions for 1908—1909 illustrates the normal succession, a considerable alteration takes place from season to season in the relative abundance of *C. appendiculata* at different depths. In summer and in both basins of the Mediterranean, the species averages much the most abundant near the surface, with mean (corrected) catches only about $^1/_{10}$ as great at 200 meters as at 16—43 meters, and about as large at 400 meters as at 200; while measurable numbers may even exist as deep as 800 meters.

Data for the western basin, give slight indication that the zone of maximum abundance may sink between June and September from near the surface to the 40—70 meter level, perhaps with slight relative enrichment as deep as 200 meters. By winter this alteration has progressed in the western basin until the species is nearly or quite as abundant at 200—400 meters as it is in the upper water layers, while in the eastern basin, at this season, it averages most numerous at 400 meters or even deeper, instead of near the surface, as is usually the case in summer. The seasonal difference is even greater for localities where dense aggregations were encountered, the richest unit catch (omitting correction) at 16—43 meters anywhere in the Mediterranean being 242 in winter, whereas 17 (or 27 $^0/_0$) of the summer stations yielded more than 1000 per unit, and 5 stations (8 $^0/_0$) more than 3000 per hour. Distribution from station to station is, however, extremely irregular. One summer station, for example, yielded upwards of 20 times as many at 200 meters as near the surface, and when the stock in small depths is sparse, the maximum may lie even as deep as 800 meters.

No definite lower boundary to the occurrence of the species is indicated, whether for winter or for summer. But while the stock appears to be very sparse, indeed, below 600 meters in summer, measurable numbers were found to a depth of at least 1600 meters in winter.

It is obvious that an alternation of the sort indicated above, i. e., increase in abundance in the deep water layers, relative to the shoal, might result either from an actual multiplication of the deep living population, or a decrease of the shoal living population.

In the present case it seems certain that seasonal impoverishment of the shoal waters was chiefly responsible, for the average number per hour caught between 50 meters and the surface was about 5—6 times as large in summer as in winter, whether for the western basin alone, or for both basins combined[1]. At the same time, some actual enrichment of the deep-living population seems also to occur, for while there is no definite evidence of any significant seasonal alteration one way or the other at the 200 meter level, considerably larger catches were made at and below 600 meters in winter than in summer.

A seasonal alternation of the sort just outlined and in the case of an animal that breeds chiefly in summer (apparently also chiefly near the surface) strongly suggests that the aging individuals tend on the whole to be dispersed progressively downward, both by the eddy-conductivity of the water, and by the fact that their specific gravity is higher than that of water, even if only slightly so. It also indicates that *C. appendiculata* is not effectively phototropic one way or the other.

### Seasonal Variations in Abundance.

The mean numbers of *appendiculata* at the stations where it occurred (calculated as explained on p. 68), and at the level of maximum abundance, were approximately:—

Winter — Western basin 91 per hour = 1 per 60 cubic meters
— — Eastern — 31 - — = 1 - 177 — —
— — Combined 80 - — = 1 - 69 — —
Summer — June — Western basin 1031 per hour = 1 per 5.3 cubic meters
— — Sept. — — — 852 - — = 1 - 6.4 — —
— — Aug.—Sept. — Eastern basin 310 per hour = 1 per 17.7 cubic meters
— — Mid-Sept. — — — 2025 - — = 1 - 2.2 — —
— — Combined 1046 - — = 1 - 5.3 — —

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[1] Taking into account only the stations where the species was taken, and where hauls were made both at 16 or 43 meters, and at 200 meters.

The maximal catches were also much larger in summer than in winter as follows:—

| | | | | | | |
|---|---|---|---|---|---|---|
| Summer — | Western basin | 4115 | per hour | = 1 | per 1.3 | cubic meters |
| | Eastern — | 7116 | - — | = 1 | - 0.8 | — — |
| | Bay of Cadiz | 11170 | - — | = 1 | - 0.4 | — — |
| Winter — | Western basin | 242 | - — | = 1 | - 22.7 | — — |
| | Eastern — | 1911 | - — | = 1 | - 4.6 | — — |

Combination of the foregoing, suggests that the total stock may be about 20 times as strong in summer (June—September) as in mid-winter (February).

### Breeding Season.

The eudoxid was first definitely identified in Villefranche, in May, by Moser (1925, p. 240) who kept specimens in aquaria until the release of cormidia, which latter lived for ten days. Specimens kept by her earlier in the season did not release cormidia, although some bore as many as 60—80 stem-groups. From this it appears that the breeding season opens in the Mediterranean in the late spring. And while no eudoxids were found in the "Thor" collection, the tremendous augmentation in abundance of adults from February to June (p. 107) similarly points to spring and early summer as a period of active reproduction. The scanty data for late August—September afford a hint that the peak of the reproductive season is reached early in summer, because catches average somewhat smaller than do the June catches. The fact that the population averaged only about $^1/_{20}$ as rich in winter as in summer points to a preponderance of death rate over production (if any occurs so late in the season) of about this same order of magnitude during the autumn.

### Abundance.

On comparing the summer stocks (when the population is largest and the available data most abundant) of several species which were found most frequently at their respective levels of greatest abundance, we find *C. appendiculata* 27 times more abundant than *Lensia multicristata*, 48 times more abundant than *L. fowleri*, and at least 4 times more abundant than *Abylopsis tetragona*[1]. Even the low winter stock of *appendiculata*, though only about $^1/_{20}$ of the summer population, is at least twice as abundant as the summer stock either of *multicristata* or *fowleri*. Nor do the maximum catches of these two more than about equal the maximal winter catches of *appendiculata* (1 per 22.7 cubic meters in the western basin), whereas the maximal summer catches of *appendiculata* were at least 44 times as great.

Thus, *C. appendiculata* is not only one of the most regularly occurring siphonophores in the Mediterranean, but also by far the most abundant. The largest catch was at the rate of 11170 per hour, or 10053 per 5000 cubic meters.

## EUDOXOIDES SPIRALIS Bigelow (p. 44).

Fig. 73.

### Horizontal Distribution.

This species, originally described from the Eastern Tropical Pacific (Bigelow, 1911 b), has subsequently been found in Japanese waters (Bigelow, 1913), Great Barrier Reef, Australia (Totton, 1932; Russell and Colman, 1935), Indian Ocean (Browne, 1926), at many localities in the South Atlantic, south to Latitude 45° S. (Moser, 1925; Leloup, 1934; Leloup and Hentschel, 1935), likewise in the Tropical and Sub-tropical North Atlantic, northward to the vicinity of the Cape Verdes (Leloup, 1934) on the one side, and in the region between Cape Hatteras, Bermuda and the Bahamas (Bigelow, 1918) on the other. It has also been recorded at the following localities in the Mediterranean:— Adriatic (Moser, 1917), Naples (Moser, 1917), Villefranche (Leloup, 1935), and at nine stations in the western basin (Leloup, 1933). Evidently, then, it is cosmopolitan in warm seas.

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[1] *H. hippopus* is not included in these calculations, though sometimes common because it is impossible to determine what relationship the number of nectophores taken, bore to the number of colonies present in the water.

Corresponding to its general affinity for relatively high temperatures, the "Thor" records for it outside the Mediterranean were all south of the latitude of Cape St. Vincent (Fig. 73), nor did the "Research" find it in the Bay of Biscay (Bigelow, 1911 a).

Inside the Mediterranean, it was generally distributed in both basins along the track followed by the "Thor", with no apparent regions of concentration. Rich hauls were correspondingly widely scattered in both the east and west. The distribution is, in short, typical of a species, the stock of which is maintained by local reproduction in both basins. Nor was there any suggestion of significant immigration from the Atlantic: the catches near the Straits, west of Longitude 0° all were small.

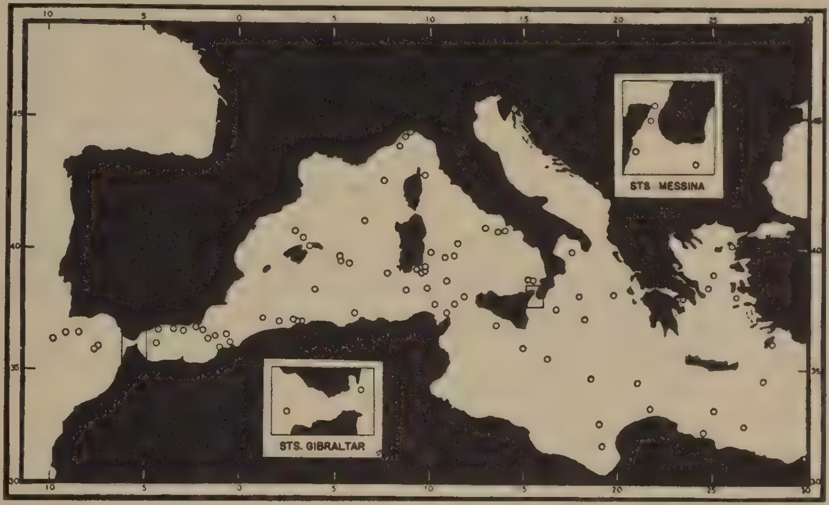

Fig. 73. "Thor" captures of *Eudoxoides spiralis*.

*E. spiralis*, seems, however, to have been absent from the Sea of Marmora: this is interesting because one might expect a species with so wide a vertical range (p. 110) to be carried thither with the undercurrent from the Aegean Sea where it was taken in moderate numbers at 3 stations. Its failure at the single station in the Adriatic was no doubt accidental, since it was found there by Moser (1917).

### Vertical Distribution.

Summer. For *spiralis*, as for perhaps all siphonophores, the distribution is so irregular from place to place — perhaps within short intervals of time — that individual stations may show it either more abundant shoal than deep or vice versa. Averages of all the catches, do, however, reveal a decided consistency.

The "Thor" data outside the Straits of Gibraltar are not sufficient to be significant in this respect, partly because it was taken there at only 2 stations in winter, two in June, and one in September, but more especially because no shoal tow was made at the station (St. 91) where the largest Atlantic catch was made (96 per hour at 200 meters). Hence the following discussion must be confined to the Mediterranean.

In the western basin of the Mediterranean, the average catch per hour (corrected) at the 22 stations where tows were made at 16 and at 200 meters, was 55 nectophores at 16 meters and 7 nectophores at 200 meters. Occasionally, it is true, the deeper haul yielded much the larger catch, but among the 8 stations where one or another haul yielded as many as 10 specimens, the 16 meter catch was 10 times as great as the 200 meter catch at 6 stations, while the reverse obtained only at two. At 8 stations where tows were made at 43 meters as well as at 16 and 200 meters, the average (corrected) numbers per hour's tow were 97 at 16 meters; 130 at 43 meters; but only 2 at 200 meters. At 3 stations where tows were made at 43 and at 200 meters, the average numbers per hour (corrected) were 16 times as great at the shoaler level as at the deeper. The mean for the 16 meter and 43 meter haul combined (54 per hour) was 8 times as great as for the 200. Actually the contrast was even wider than this 8 to 1 relationship might imply, for while only 10 out of 34 (or 29%) shoal hauls (at the 25 stations where the species was taken at some level), failed to yield it, 17 out of 25 (or 68%)

were blank at 200 meters, if we allow for contamination[1]. Furthermore, the maximum catch per hour (corrected) was much greater at 16 meters (433 colonies) and at 43 meters (333 colonies) than at 200 meters where it was only 30 colonies.

The catches, in summer tows, at depths greater than 200 meters were as follows (Table 35).

Table 35.

| Depth of tow | Hauls at stations where taken | Catch per hour (uncorrected) |
|---|---|---|
| 400 | 3 | 2, 0, 10 |
| 666 | 3 | 0, 0, 0 |
| 600 | 1 | 2 |
| 800 | 3 | 0, 0, 0 |

Although the distribution is so irregular that the average abundance at different levels is influenced by the particular group of stations under consideration, the foregoing is good evidence that the chief zone of abundance of *spiralis* in the western basin in summer was in the upper strata centering somewhere between the surface and 50—60 meters, that the species averaged perhaps not more than $^1/_8$ to $^1/_{10}$ as numerous at 200—400 meters, and that it occurred only casually at greater depths.

In the eastern basin, available data suggest a somewhat different depth-relationship, i. e. great scarcity (instead of abundance) close to the surface as illustrated by the 16 meter hauls, combined with comparatively uniform abundance from 40—50 meters down to 200 meters, average numbers (corrected) per hour, at the 13 pertinent summer stations, being as follows:—

| | | |
|---|---|---|
| 16 meters | 11 tows | 6 colonies |
| 43 — | 2 — | 68 — |
| 200 — | 11 — | 58 — |

It is unfortunate, in the present instance, that so few tows were made at 43 meters, for the irregularity of distribution, from station to station, forbids any conclusion, whether the whole stratum from 43 meters down to 200 meters was one of roughly equal abundance, or whether it chanced that the two tows in question were made at stations where *spiralis* was unusually scarce at the shoaler of these two levels[2]. Paucity of data similarly makes it doubtful whether the small yields of two hauls at 400 meters — a total of only 4 specimens — actually indicates a correspondingly sudden impoverishment of the population in the eastern basin with increasing depth below 200 meters. But a mean hourly catch of only 8 (uncorrected, or 3 corrected) in 7 hauls at 666 meters, contrasted with about 60 at 200 meters, seems sufficient evidence that the population is decidedly impoverished below say, 300—400 meters in the eastern basin, as is also the case in the western. And while the population at individual stations may be richer deep than shoal (as at St. 147, where the haul from 666 meters yielded 18, the haul from 200 meters none at all) it is doubtful whether significant numbers were living deeper than 600 meters in the eastern basin, for the catches in hauls from 800 meters and deeper, were so small that they may all have been picked up by the nets at lesser depths.

Winter. Catches at the 14 winter stations in the western basin, where *spiralis* was taken, show essentially the same vertical distribution as in summer, i. e. concentration near the surface, with a sparse population extending down to about 400 meters, as follows (Table 36).

Table 36.

| Depth | No. of hauls | Extreme catches per hour | Mean catch per hour (corrected) | Ratio |
|---|---|---|---|---|
| 16 | 3 | 0—241 | 63 | 10 |
| 43 | 5 | 0— 88 | 42 | 7 |
| 200 | 6 | 0— 64 | 14 | 2 |
| 400 | 2 | 0— 74 | 37 | 6 |
| > 400 | 1 | 0 | 0 | 0 |

Taken at face value, the foregoing would suggest slightly greater relative abundance, in the deeper strata in winter than in summer. But with such wide variations from station to station, hauls made at slightly different localities would no doubt have yielded somewhat different results. For the same reason, one can only say, of the eastern basin, that *spiralis* was rather definitely concentrated close to the surface at the two winter stations where it was taken (St. 10, 11, Table 37), instead of deeper down as seems to have been the prevailing state in summer (p. 110).

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[1] Actually there were 11 blank hauls (or $44^0/_0$) at 200 meters.

[2] Corrected numbers per hour at these stations were:—
St. 183. 43 meters, 104; 200 meters, 8.
St. 186. 43 meters, 36; 300 meters, 8.

Summer and winter combined. The catches of *E. spiralis* for all the Mediterranean hauls made at the stations which yielded it are combined in Table 38.

This distribution is in line with the fact that the great majority of the *spiralis* taken by the "Meteor" were from hauls from 0—50 and 50—100 meters (LELOUP and HENTSCHEL, 1935) with only a few from the deeper closing nets. Most of the "Albatross" series (BIGELOW, 1911b; 1913) were also from the surface hauls.

Thus it seems that over its range as a whole, the species averages much the most abundant within, say, 100 meters of the surface and often close to the surface. It has, however, been taken so often in open hauls from great depths[1], as well as in a few closing net hauls down to at least 800 meters (BROWNE, 1926; LELOUP and HENTSCHEL, 1935) as to make it very probable that wherever it is plentiful in the shoal strata, a sparse population of it may be expected to extend downward to an indefinite depth.

Table 37. Winter catches in the eastern basin, Stations 10, 11.

| Depth | Hauls | Extreme catches per hour | Mean No. per hour (corrected) | Ratio |
|---|---|---|---|---|
| 16 | 2 | 2—234 | 118 | 10 |
| 43 | 2 | 0— 1 | 1 | 1 |
| 200 | 2 | 0 | 0 | 0 |
| 400 | 1 | 17 | 17 | 1 |
| 666 | 1 | 0 | 0 | 0 |
| 800 | 1 | 0 | 0 | 0 |

Table 38.

| Depth | No. of hauls | Extreme catches per hour | Mean No. per hour (corrected) | Ratio |
|---|---|---|---|---|
| 16 | 45 | 0—333 | 49 | 10 |
| 43 | 30 | 0—433 | 30 | 6 |
| 200 | 46 | 0—374 | 19 | 4 |
| 666 | 10 | 0— 74 | 2 | 0.4 |
| 800 | 11 | 0— 1 | < 1 | < 0.2 |

## Seasonal Variation in Abundance.

The average numbers, per hour's towing, at the respective levels of maximum abundance, for all stations in the Mediterranean combined, where it was taken were:—

Summer:— 36 stations, about 80 per hour (corrected).
Winter:— 8 stations, about 85 per hour (corrected).

While the closeness of this agreement is perhaps fortuitous, there is certainly no indication here of any great variation in the average abundance in winter and summer. Maximum abundance similarly differed little, if chance variation be taken into account:—

Summer:— 433 per hours tow (corrected).
Winter:— 242 per hours tow (corrected).

In short it seems that no definite alternation takes place in the strength of the population between summer and winter. However, the relative frequency of this species seems significantly greater in the warm half of the year than in the cold, for it was taken at 49 % of all summer stations in the Mediterranean, where tows were made at 43 meters or deeper, but at only 21 % of corresponding winter stations.

## Breeding Season.

In the cases of most of the other diphyids of the Mediterranean, the breeding season is reflected in a great increase in abundance (at some level in the water) from mid-winter to early summer. This, however, is not the case for *E. spiralis*, the numbers of which showed no great change from season to season (p. 111). On the contrary, captures of gonophores or of free eudoxids at 50 % of the stations at which the species was taken at any depth in winter, and at about 30 % of the summer stations of occurrence, suggests that it breeds about as generally in the cold half of the year as in the warm, though with the possibility still open that breeding is most active at periods of the year not covered by the "Thor" cruises.

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[1] Most of the *spiralis* taken by the "Gauss" (MOSER, 1925) were from vertical hauls from 400 meters to the surface, and some from open nets from much greater depths.

## LENSIA CONOIDEA Keferstein and Ehlers (p. 48).

Fig. 74.

### Horizontal Distribution.

Since *L. fowleri* and *L. subtiloides*, or both, have often been treated as synonyms of *L. conoidea*, it is not possible to delimit the range of the latter from the published accounts. There are definite records of it from the northern Pacific, the Malayan region, the Gulf Stream and the coast of Norway. It also seems probable that it was represented among the specimens recorded as "*truncata*" from the South Atlantic to almost 60° S. by Moser (1925), Leloup (1934), Leloup and Hentschel (1935), and by Hardy and Gunther (1935) and from the Mediterranean by Moser (1917), Leloup (1933). It was originally described from Naples by Keferstein and Ehlers (1860), and has since been reported there by Spagnolini (1868, 1870). Lochman (1914) and Leloup (1935) also record it from Villefranche. The "Thor" records include the Bay of Biscay, and the offing of Portugal (Fig. 74). They also now show it to be widespread in the western basin of the Mediterranean, for it was taken, at least in small numbers, at 63 % of the stations there in mid-January (19 out of 30 stations), at 51 % (16 out of 31) of the June stations, and at 40 % (11 out of 28) of August stations. The captures, furthermore, are so generally distributed along the route of the "Thor" that it is probable that the stock in the western basin is self-maintaining, with little if any help from immigration from the neighboring Atlantic, where the species was also generally distributed winter and summer (Fig. 74).

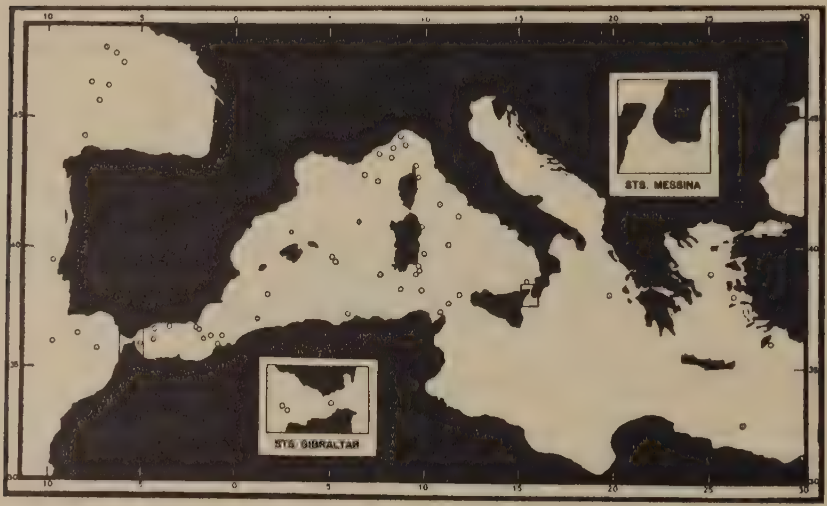

Fig. 74. "Thor" captures of *Lensia conoidea*.

In the eastern basin and tributaries, on the contrary, it was not taken at all during the winter cruise (10 stations), and at only 8 out of 27 of the summer stations — evidently it is much less regular there than in the western basin. And most of these eastern basin records are based on very few specimens (a total of 16 for 25 of the stations). But two very rich catches in the Sea of Marmora bespeak very active local reproduction there, one of 1665 nectophores in a haul from 66 meters being the richest of all.

### Vertical Distribution.

Previous records of this species have shown that its vertical range is a wide one, extending from the surface down to very considerable depths. Thus, in Norwegian waters, as illustrated by the Bergensfjord, it is to be found at all depths, i. e., down to some 400 meters (RUNNSTRÖM, 1932). The "Meteor" expedition also had it at many stations in hauls varying from 0—50 meters down to 900—1100 meters.

A wide vertical range again appears, from the "Thor" data, the catches per hour (corrected) for all the hauls Atlantic and Mediterranean combined, made at stations where *conoidea* was taken at any depth, being shown in Table 39.

Table 39.

| Depth | No. of hauls | Extreme catches per hour | Mean | % hauls where *conoidea* taken |
|---|---|---|---|---|
| 6, 16, 43 | 68 | 0— 80 | 2 | 30 |
| 66 | 4 | 0—1665 | 421 | 75 |
| 133, 166, 200 | 47 | 0— 349 | 27 | 64 |
| 400, 466, 532, 666 | 25 | 0— 192 | 17 | 52 |
| 800, 932, 1066 | 13 | 0— 592 | 57 | 60 |
| 1332 | 5 | 1— 107 | 57 | 100 |

The combined picture is, thus, of a species occurring much more regularly, and in much greater numbers, below than above the 40 meter level, and one which may occasionally occur in large numbers at any depth down to the greatest sampled by the "Thor" (1300—1400 meters). Mean catches, taken alone, would suggest a definite maximum at the 66 meter level. But as this resulted from a single rich catch, it was very likely a matter of pure chance that the calculation gave so high a mean value at this particular level, and not at some other.

Separation of the Atlantic from the Mediterranean catches reveals a regional contrast of the same sort as for several other species, in that the lower limit to regular occurrence lies considerably deeper in the Mediterranean (> 800—1000 meters) than in the Atlantic (about 600 meters), as follows (Table 40).

Table 40.

| Depth | Atlantic | | | Mediterranean | | |
|---|---|---|---|---|---|---|
| | No. of hauls at stations where taken | Extreme catches per hour corrected | Mean catch per hour corrected | No. of hauls at stations where taken | Extreme catches per hour corrected | Mean catches per hour corrected |
| 6, 16, 43 | 19 | 0— 19 | 2 | 50 | 0— 12 | 2 |
| 66 | 0 | 0 | 0 | 4 | 0—1665 | 421 |
| 133, 166, 200, 266 | 11 | 0—349 | 88 | 30 | 0— 281 | 24 |
| 400, 466, 533, 666 | 6 | 0—192 | 46 | 19 | 0— 107 | 10 |
| 800, 933, 1066, 1333 | 4 | 0— 5 | 1 | 15 | 0— 592 | 67 |

Segregation of the data by seasons, whether for Atlantic and Mediterranean stations combined (Tables 41, 42), or for the latter alone, shows that the upper 40 meters, sparsely populated in winter, become almost entirely depleted of *conoidea* in summer. It also suggests that on the whole, the zone of most regular occurrence lies shoaler in winter, i. e., at 200—600 meters, than in summer when blank hauls were on the whole relatively fewer at depths of 800 meters or more[1]. If this be actually characteristic, it points to a general sinking, of the population from winter to summer. But the variations in the catch from station to station are so great (note especially the tremendous catch in the one summer haul at 66 meters) that far more data would be needed before a definite statement could be made.

The comparative scarcity of *L. conoidea* in the upper 50 meters the year round, and its almost complete disappearance from the overlying strata in summer in the Mediterranean, but the widespread occurrence thence down to great depths, contrasts with its vertical distribution in the Atlantic between 20° N. and 35° S., where the "Meteor" closing net hauls (LELOUP and HENTSCHEL, 1935) show it as occurring most frequently

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[1] This generalization leaves out of account the ostensible 100% frequency, in summer, at 66 meters. But this depended on a single haul only; had more hauls been made at this level, at stations where *conoidea* occurred, a very different frequency might have resulted.

Table 41. Winter.

| Depth | No. of hauls at stations where taken | Catch per hour corrected |  | °/₀ of hauls taking *conoidea* |
|---|---|---|---|---|
|  |  | Extremes | Mean |  |
| 16, 43 | 25 | 0— 80 | 5 | 36 |
| 66 | 3 | 0— 15 | 7 | 67 |
| 133, 200 | 16 | 0—349 | 64 | 69 |
| 400, 466, 666 | 9 | 0—107 | 19 | 70 |
| 1066, 1333 | 7 | 0— 11 | 2 | 58 |

Table 42. Summer.

| Depth | No. of hauls at stations where taken | Catch per hour corrected |  | °/₀ of hauls taking *conoidea* |
|---|---|---|---|---|
|  |  | Extremes | Mean |  |
| 6, 16, 23, 43 | 43 | 0— 16 | 1 | 19 |
| 66 | 1 | 1665 | 1665 | 100 |
| 133, 200 | 32 | 0— 41 | 7 | 63 |
| 400, 466, 666 | 18 | 0— 281 | 30 | 45 |
| 800, 1066, 1333 | 11 | 0— 592 | 91 | 82 |

at depths less than 200 meters, irrespective of the time of year. And its vertical distribution is of still another type in the Bergensfjord, where Runnström (1932) describes it as present in the deeper layers throughout the year, but as rising to the upper 100 meters only between March and September, to the surface only in August.

### Seasonal Variation in Abundance.

The vertical range of this species being so wide and the variations in abundance from station to station so great, the best approximation to a true picture of the relative abundance at different seasons may be expected from comparison of the mean abundance for all levels combined. This is 19 nectophores (corrected) per hour's tow for winter; 55 for summer, if the one phenomenal catch at 66 meters be omitted; 259 if the latter be included in the calculation. Apart, however, from this one case, the maximal catches did not differ very greatly from season to season, though with some preponderance in favor of summer, i. e., 107 and 349 per hour in winter; 281 and 592 per hour in summer (see Tables 41, 42).

### Breeding Season and Depth.

The fact that the species was somewhat more abundant in summer than in winter, points to an excess of production over death rate between February and June[1]. And the tremendous catch made in the Sea of Marmora on August 11, 1910, was clearly the result of a local wave of early summer breeding. But the presence of considerable numbers of *L. conoidea* in winter as well as in summer, contrasting with the wide seasonal fluctuation which obtains for sundry other calycophores, is evidence that some reproduction also takes place in the autumn. This accords with Runnström's (1932) discovery that eudoxids are present throughout the year in Norwegian waters. The vertical distribution described above (p. 113) indicates that eudoxids are set free, and that the larval stages are passed, throughout the whole vertical range of this species, but with the chief production taking place at depths greater than 50—60 meters. In fact it is doubtful whether any significant production, in the Mediterranean, ever takes place close to the surface. In this phase of its life history, the stock living in different localities show interesting contrasts correlated no doubt with hydrologic conditions, but in ways not yet clear. In some Norwegian localities, illustrated by the Bergensfjord, eudoxids occur regularly near the surface as well as deep, at least in summer (Runnström, 1932), but in others i. e. in the Oslofjord, they have been described as confined to the surface waters (Sverdrup, 1921).

### Abundance.

Mean abundance at all depths combined, at stations where the species was taken, was 22 per hour (corrected) or 1 per 250 cubic meters of water in winter; 33 per hour (corrected) or 1 per 166 cubic meters of water in summer; or if the upper 50 meters of water be omitted, 39 per hour (corrected) or 1 per 141 cubic meters of water in winter, 53 per hour (corrected) or 1 per 107 cubic meters of water in summer.

The maximum catches at any level were:—

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[1] Leloup (1935) found eudoxids common in spring.

349 per hour (corrected) or 1 per 13 cubic meters of water in the Atlantic in winter, 192 per hour (corrected) or 1 per 29 cubic meters of water in summer: 250 per hour (corrected) or 1 per 22 cubic meters of water in the western basin in winter, 592 per hour (corrected) or 1 per 9 cubic meters of water in summer: 1665 per hour (corrected) or 1 per 3 cubic meters of water in the Sea of Marmora in summer.

## LENSIA FOWLERI Bigelow (p. 53).

Fig. 75.

### Horizontal Distribution.

The original series (Bigelow, 1911 a) was from the Bay of Biscay, where the "Thor" again had it at eight stations, likewise at two in the Bay of Cadiz (Fig. 75). Specimens unmistakably identifiable as *fowleri* have also been recorded from the West Indies (Bigelow, 1911 b, 1918); the Eastern Tropical Pacific (Bigelow, 1911 b); off the Great Barrier Reef, Australia (Totton, 1932; Russell and Colman, 1935); the Indian Ocean (Browne, 1926); and the Southern Atlantic (Leloup, 1934; Moser, 1925). *L. fowleri* has not been recorded previously in the Mediterranean under its own name, but it may have been represented among specimens reported thence by Moser (1917) and by Leloup (1933) as "*truncata*" (*L. conoidea*, p. 48, 112), for the "Thor" collection shows it to be widespread in both basins.

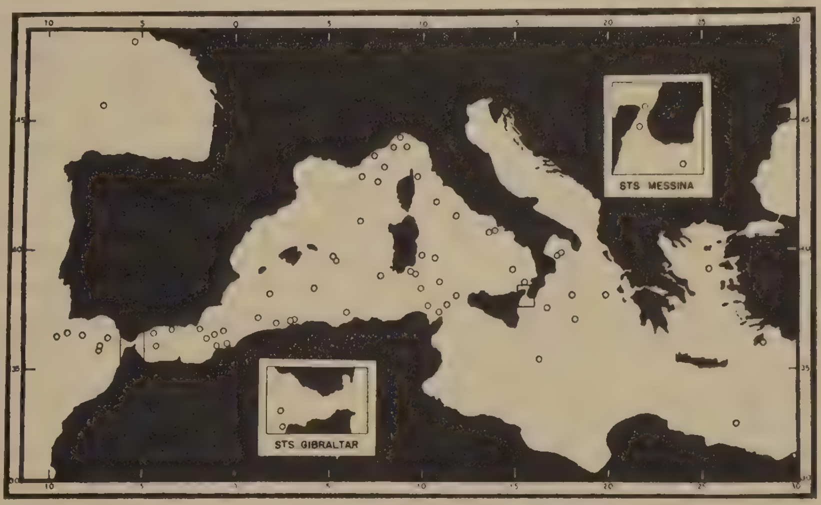

Fig. 75. "Thor" captures of *Lensia fowleri*.

In the western basin (summer and winter), it was taken at 45 out of 57 stations where tows were made at 200 meters or deeper — and also at two stations (57, 58) where the deepest towing levels were 133 and 66 meters respectively, the localities of occurrence (Fig. 75) being generally distributed along the routes traversed by the "Thor". The presence or absence (apart from abundance) of the species at various stations suggests some concentration in the Alboran Sea, between Sardinia and the Pantellarian Channel, and in the region between Corsica and the French Riviera, contrasting with an apparent scarcity in the Catalonian Sea and to the southwest of Central Italy. But the distribution of captures is not regular enough to show whether, or to what degree, these apparent regional differences are associated with the major circulatory movements of the western basin (outlined by Nielsen, 1912, Pl. 11).

In the eastern basin, the species seems to have been more regularly distributed in the northern part (Ionian and Aegean Seas) than in the southern to the south of the latitude of Crete, for it was taken at 14 out of 17 deep towing stations ($82\,^{0}/_{0}$) in the former subdivision, but at only one of the seven deep towing stations ($14\,^{0}/_{0}$) in the latter. Yet there is no evidence that it penetrates the Adriatic, the Sea of Marmora, or the Black Sea.

The fact that the localities of record are so widespread argues that the populations in the two basins are indigenous, i. e. not dependant for their persistence on immigration either from the Atlantic via the Straits of Gibraltar or from the one basin to the other via the Pantellarian Channel. The general tendency of this species to hold to the deeper water layers would, indeed, make it more likely that the Mediterranean contributes it to the Atlantic, than the reverse, though the catches just inside and just outside the Straits of Gibraltar were so small that no mass-movement can have been taking place in either direction at the times of the cruises. In the case of the Pantellarian Channel, the catches per hour (corrected) at Stations 137, 138 and 139 (Table 43) seem to have favored some drift of *fowleri* northward (i. e., from the eastern basin to the western) in the undercurrent (see NIELSEN, 1912, Fig. 11).

Table 43.

| Depth | St. 137 | St. 138 | St. 139 |
|---|---|---|---|
| 16 | 0 | 0 | 0 |
| 166 | 10 | — | — |
| 200 | — | 0 | 107 |
| 533 | — | — | 0 |
| 666 | — | 10 | — |

But there being no definite upper boundary to the occurrence of *fowleri*, no doubt a certain number come within the sweep of the surface drift in the opposite direction.

## Vertical Distribution.

In general, there were only trifling numbers of *fowleri* in the surface layers (16 and 43 meters). The few tows at 66 and 133 meters showed it somewhat more abundant at these levels. A much richer population was found near 200 meters, with the population again averaging only about $^{1}/_{4}$ as great at 400 meters as at 200. Deeper than this, it seems that *fowleri* was only a stray, since most of the deep catches were negligible if the probable contamination from the overlying layers be allowed for, as illustrated by Table 44 which includes all Mediterranean stations winter and summer, where the species was taken.

Table 44.

| Depth | No. of tows | Extreme catches per hour (corrected) | Mean No. per hour (corrected) |
|---|---|---|---|
| 16 | 37 | 0— 0 | 0 |
| 43 | 25 | 0— 2 | < 1 |
| 200 | 45 | 0—278 | 38 |
| 400 | 11 | 0— 40 | 11 |
| 666 | 13 | 0— 12 | 3 |
| 800 | 6 | 0— 13 | 2 |
| > 800 | 7 | 0 | 0 |

While the Atlantic catches were too small for much statistic significance, they yield much this same picture so far as they go, at the stations where *fowleri* was taken, and where hauls were made deep, as well as shoal, (Table 45).

Table 45.

| Depth | No. of hauls | Extreme catches per hour (corrected) | Mean No. per hour (corrected) |
|---|---|---|---|
| 16, 43 | 12 | 0— 2 | 0 |
| 200 | 8 | 0— 34 | 7 |
| 400 | 4 | 0— 1 | < 1 |
| 666, 800 | 3 | 0— 1 | 1 |
| 1066 | 2 | 0— < 1 | 1 |

Segregation of the Mediterranean data by seasons shows that the largest catches were made at about the same depth (near 200 meters) in winter as in summer, whether for the Mediterranean as a whole or for the western basin alone. Neither does any seasonal variation appear in the location of the uppermost limit to its regular occurrence, in spite of the difference of about 7° C. in the temperature (13.5°—21° C. in the western basin) of the upper strata between the warmest and the coldest seasons. Actually, the two records in the 6 and 16 meter hauls were for July and August, while the four records for 43 meters were in January, February, June, and July. The summer hauls for the Mediterranean also closely correspond with the combined winter-summer picture, as respects the decrease in the abundance with depth from 200—400 meters downward, and in the existence of a sparse population down to depths greater than 666 meters. It is unfortunate that no systematic towing was done between 43 and 200 meters, for this gap in the data leaves open the possibility that the center of abundance for this species may have lain somewhere between these levels, or (more likely) that it may have been as abundant at 100 meters as at 200. And the earlier records of the species equally leave this question open. Thus the distribution of catches in the Bay of Biscay in vertical hauls with open nets (4 from 0 meters; 4 from 91—0 meters; 7 from 137—0 meters; 39 from 183—0 meters; 1 from 457—0 meters; and 4 from 550—0 meters; BIGELOW, 1911 a) contrasted with the fact that seven closing-net hauls from 180—366 meters failed to take it, suggests a concentration not far from the 150 meter level. And BROWNE (1926) similarly records this species from 8 open hauls from 180—0 meters in the Indian Ocean, but not in hauls from 137—0 meters. On the other hand, the "Meteor" data suggest a comparatively uniform distribution, from a depth not greater than 50 meters down to perhaps 200 meters, with occasional specimens living at least as deep as 600 meters, as appears from the following calculation (Table 46) from LELOUP and HENTSCHEL's (1935) tables of specimens caught per 100 meters of towing, in vertical hauls with closing-nets[1].

Table 46.

| Depth, meters | No. of hauls at "Meteor" stations where taken | No. of specimens per 100 meters of towing |
|---|---|---|
| 0— 50 | 4 | 1 |
| 50—100 | 11 | 2 |
| 100—200 | 3 | 1 |
| 200—400 | 7 | 0.14 |
| 400—600 | 1 | 0.5 |
| 600—800 | 2 | 0.5 |

The Eastern Pacific series collected by the "Albatross" (BIGELOW, 1911 b), were all from hauls with open nets from 550—0 meters; none were taken in the surface hauls. Most of the "Bache" series from the Western Atlantic (BIGELOW, 1918) were also from open hauls from depths ranging from 1000—0 to 200—0 meters, a few, however, from the surface. And towings made in 1908 in West Indian waters from the S. Y. "Virginia" yielded it twice from 150—0 meters[2], but not at all at the surface.

Combination of the foregoing, shows that while *L. fowleri* may occasionally appear right up to the surface, its zone of chief abundance and most regular occurrence is usually at about 100—200 meters, throughout its horizontal range.

## Seasonal Variation in Abundance.

*L. fowleri* was taken at 40 out of 51 summer stations ($79\,^0/_0$, western and eastern basins combined) in the Mediterranean, where tows were made at 200 meters or deeper. In winter, it was taken at 15 out of 24 stations ($63\,^0/_0$) with tows at 200 meters or deeper and also at two shoaler stations (57, 58). Considering the wide margin of error inherent in calculations of this sort, we find no evidence here of any significant difference in the frequency of this species, between winter and summer; in this it contrasts strongly with *L. multicristata*, for example (p. 119).

But the population was much more abundant in summer than in winter. Thus the maximum catches in the western basin were 278 nectophores (corrected) per hour in summer, but only 18 nectophores (corrected) per hour in winter. Indeed, all the 15 hauls which yielded 20 or more *fowleri* per hour there were made in the months of June, July, and August, whereas only 7 winter catches at any depth yielded as many as 10 per hour.

In the eastern basin also, the mean catches per hour were also about 5 times as great in summer (mean, 22 per hour corrected, in 13 tows) as in winter (mean, corrected, about 4 per hour in 7 tows)[3].

## Breeding Season and Abundance.

The facts that the species was several times as abundant in summer as in winter in the more populous layers, and that the densest populations were also encountered in summer, is good evidence that reproduction takes place most actively at some time between January—February and July—August, there being no evidence that this increase was due to waves of immigration. No young were found. But the facts that the species appears only casually in the shallow (43 meters) tows, that the level of chief abundance was as deep in summer as in winter, and that the vernal augmentation is most marked at the depths where the species is already most numerous, are good evidence that the chief reproduction of this species takes place in the deeper layers, i. e., at 100—200 meters or thereabouts. Whether reproduction was still continuing during the summer cruise, or whether a definite number of broods are produced per year, cannot be determined from the collections. It is, however, interesting that the indicated vernal augmentation is much smaller for *L. fowleri* than for *L. multicristata*. But this difference does not necessarily mean that reproduction is not as successful for *fowleri* as for *multicristata*, it being equally possible that breeding for the former was at its peak either earlier in the season than the date of the summer cruises of the "Thor", or later.

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[1] The calculation includes all closing-net hauls made at the stations where the species was taken at any depth.

[2] Specimens now in the Museum of Comparative Zoology.

[3] Considering only stations where *fowleri* occurred.

The richest Mediterranean catches were at the rate of 278 per hour or 250 per 5000 cubic meters in summer, 18 per hour in winter. The richest Atlantic catch (at any season) was 34 per hour.

## LENSIA MULTICRISTATA Moser (p. 55).

Fig. 76.

### Horizontal Distribution.

Earlier reports have shown this species to be widespread in the Eastern Tropical Pacific (Bigelow, 1911 b), in the Indian Ocean (Browne, 1926), in the South Atlantic (Moser, 1925; Leloup, 1934; Leloup and Hentschel, 1935), and as far north in the North Atlantic as the Bay of Biscay (Bigelow, 1911 a). It was therefore no surprise to find it at several "Thor" stations in the Bay of Biscay, off the coast of Portugal and in the Bay of Cadiz (Fig. 76).

It had previously been overlooked in the Mediterranean, but the "Thor" data now prove it to be widespread in the western basin, where it occurred at 28 (58%) of the 48 stations where tows were made at 200 meters or deeper, the localities being generally distributed, winter and summer, from north to south, and from east to west (Fig. 76). It seems, however, that the Pantellarian Channel marks the eastern limit of its regular occurrence, for it was taken at only seven widely scattered stations in the eastern basin, and not at all in the Adriatic, in the Aegean Sea or in the Sea of Marmora.

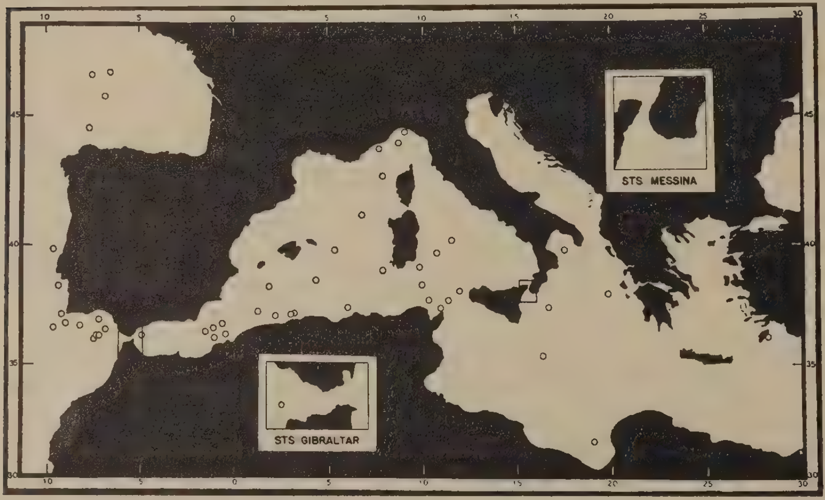

Fig. 76. "Thor" captures of *Lensia multicristata.*

The species was also less numerous at the stations where it did occur in the eastern basin than in the western, the mean catch per hour, at the level of greatest abundance, being only 19 in the one case (maximum, 53), but 100 in the other (maximum, 392).

### Vertical Distribution.

With one exception, the previous captures of the typical form of *L. multicristata* were with open nets from considerable depths. Thus, in the Bay of Biscay, the "Research" failed to take it at all in 16 hauls at the surface or in 12 hauls from 46—0 meters: only one haul out of 13 from 91—0 meters yielded it (10 specimens), and only 4 out of 22 hauls from 180—0 meters (a total of 11 specimens). But 2—3 specimens were taken in each of 5 hauls from 274—0, 366—0, and 457—0 meters[1]. Similarly, all but one of the "Gauss" series of 73 specimens were from vertical hauls from 1500—0 and 3000—0 meters, the sole exception being from the surface (Moser, 1925). Browne's (1926) five Indian Ocean specimens were from open hauls from depths of 732 meters or more, none from the many shoal tows. And the one specimen reported by Leloup and Hentschel (1935) was from a closing net from 400—600 meters. All the "Meteor" records for the *grimaldii* form (p. 57), were also from depths of at least 200 meters, most of them from at least 400 meters.

Table 47.

| Depth | Tows at stations where taken | Extreme catches per hour corrected | Mean number per hour | Mean number of cubic meters of water, per specimen |
|---|---|---|---|---|
| 16 | 18 | 0— 2 | < 1 | > 5500 |
| 43 | 7 | 0 | 0 | — |
| 200 | 19 | 0—259 | 34 | 161 |
| 400 | 4 | 0—392 | 151 | 36 |
| 666 | 5 | 2—211 | 74 | 74 |
| 800 | 2 | 0 | 0 | > 5500 |
| > 800 | 5 | 0— 5 | 1 | 5500 |

The foregoing is good evidence that this species occurs chiefly at a depth of several hundred meters, only occasionally near the surface. And the "Thor" data show that this applies equally to it in the Mediterranean. In the western basin, the calculation, whether for all seasons combined (28 stations), or for summer alone (23 stations), shows it as occurring only casually shoaler than 43 meters, as increasing in abundance downward from 200 meters to a maximum at about 400 meters and as decreasing, again, from this level, downward, mean numbers (corrected) per hour's tow for the summer cruise being shown in (Table 47).

This locates the maximum for this species as about 200 meters deeper than for *L. fowleri*, and 350 meters deeper than for *Chelophyes appendiculata* (pp. 116, 103, Fig. 83). Present indications are that the lower boundary to its regular occurrence is at about 700—800 meters. And an analysis of the five winter catches yields no evidence that the level of maximum abundance in the western basin lies any closer to the surface or that it rises toward the surface tows any more often in summer than in winter.

*L. multicristata* was taken at so few stations (7) in the eastern basin that conclusions as to its vertical distribution are not so well based for that part of the Mediterranean as for the western. It is, however, striking that whereas it was taken frequently in 200 meter hauls in the latter, it was only taken in tows from 400 meters or deeper in the eastern basin, as appears from the table of catches (corrected) per hour's towing there (Table 48).

Table 48.

| St. | 43 meters | 200 meters | 400 meters | 666 meters | 800 meters | 1333 meters |
|---|---|---|---|---|---|---|
| 10 | 0 | 0 | 41 | — | 0 | — |
| 13 | 0 | 0 | — | 13 | — | — |
| 143 | — | 0 | — | 1 | — | — |
| 144 | — | 0 | — | — | — | 1 |
| 147 | — | 0 | — | 7 | — | — |
| 160 | — | 0 | — | 53 | — | — |
| 186 | 0 | 0 | — | — | 40 | — |

It is interesting that comparison of Mediterranean catches, just discussed, with Atlantic catches shows the regular range of this species as extending downward about as far in the Atlantic (to about 666 meters) as in the western basin of the Mediterranean, in which it differs from such other species as *Enneagonum hyalinum* (p. 86), *Abylopsis tetragona* (p. 89), *Muggiaea atlantica* (p. 100), *Chelophyes appendiculata* (p. 103), and *Lensia conoidea* (p. 113).

### Seasonal Variation.

Segregation of the catches according to the time of year shows that this species was much more generally distributed through the western basin in summer than in winter, as follows:—

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[1] It was not taken in any of the closing net hauls, deep or shallow.

| | | |
|---|---|---|
| Summer:— | Stations with hauls at 200 meters or deeper | 40 |
| | with *multicristata* | 21 = 52 % |
| | Stations with hauls at 400 meters or deeper | 19 |
| | with *multicristata* | 11 = 58 % |
| Winter:— | Stations with hauls at 200 meters or deeper | 18 |
| | with *multicristata* | 5 = 28 % |
| | Stations with hauls at 400 meters or deeper | 10 |
| | with *multicristata* | 3 = 30 % |

It is also clear that a considerable augmentation takes place in the abundance of the species there, from early winter to summer, at the level of maximum abundance, smaller increases at other levels, mean abundance (corrected) at different levels being as follows (Table 49) at stations where taken.

Table 49.

| Depth | Winter | Summer |
|---|---|---|
| 43 meters 1 specimen per | 5500 Cu. M. of water; | > 5500 Cu. M. of water |
| 200 — 1 — - | 275 — - — ; | 161 — - — |
| 400 — 1 — - | 687 — - — ; | 36 — - — |
| 666 — 1 — - | < 5500 — - — ; | 74 — - — |
| 800 — 1 — - | < 5500 — - — ; | <5500 — - — |

Otherwise expressed, while the species was equally scarce (almost non-existent) close to the surface on the one hand and at and below 800 meters on the other, it was about 1.5 times as numerous at 200 meters, about 19 times as numerous at 400 meters, and more than 70 times as numerous at 666 meters in summer as in winter. And omission, from the calculation, of the correction for contamination, would not much affect the picture.

Similarly, the maximum abundance was significantly larger in summer (one specimen per 14 cubic meters of water at 400 meters) than the winter maximum (1 specimen per 55 cubic meters of water which happened to be at 200 meters)[1].

In the eastern basin, however, the frequency of occurrence at the stations where hauls were made deep enough (200 meters or more) to catch the species, if present, was about the same in winter (2 out of 7 stations = 29 %) as in summer (4 out of 19 stations = 21 %), nor was there any significant seasonal variation in the number of specimens taken.

### Interchanges via the Straits of Gibraltar and via the Pantellarian Channel.

The "Thor" stations just inside the Straits of Gibraltar yielded a considerable number of *multicristata* in hauls from 200 meters (255 specimens in 6 hauls), but none at all in hauls from 43 meters or from 16 meters. Thus, the upper boundary of the species was close enough to the surface, at the time, to come within the sweep of the outflowing bottom current. And all but one of the *multicristata* (171 specimens in 14 hauls) taken outside the Straits were also from hauls at 200 meters or deeper, with maximum catches in the 400 and 666 meter hauls, i. e., from depths too great to be affected by the inflowing surface drift, and for the most part deeper than the sill-depth of the straits.

This, added to the generally bathypelagic habit of the species (p. 118) suggests a greater probability of significant numbers being carried out of the Mediterranean than into the latter, but makes it unlikely that interchange, in either direction, is of sufficient magnitude, much to affect the local abundance of the species.

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[1] Assuming that the entire catch was made in the horizontal parts of the tow in each case.

Vertical distribution argues, similarly, against mass contributions from the western basin through the Pantellarian Channel, into the eastern basin, which accords with the fact that the species is so much less widespread in the latter, and so much less abundant there. It is possible, however, that the presence of *L. multicristata* in the eastern basin, at all, depends on occasional immigration, for conditions favored such an event on the date of Station 137, when the capture of 118 specimens per hour in a tow from only 166 meters in the Channel suggests the presence of considerable numbers shoal enough to be caught in the eastflowing water (NIELSEN, 1912, p. 134). The contrast between western and eastern basins, with regard to seasonal variation, outlined above, also argues that the stock existing in the latter is supported by immigration from the west, as well as by local reproduction.

On the other hand, the fact that all catches in the eastern basin were in nets working as deep as 400 meters or deeper suggests impoverishment of the local stock by drifting in the opposite direction with the undercurrent. Theoretically, then, we might expect intermittant movements of individuals eastward at and slightly above the 200 meter level on the one hand, and westward in the bottom waters of the channel on the other. With so complex an interrelation, it is hardly to be expected that so few localities of capture could throw any light on the lines of dispersal.

### Breeding Season, Breeding Area and Abundance.

The failure to find any juvenile stages of this small species was to be expected, with catches from nets of comparatively coarse mesh. Nevertheless, the quantitative distribution of the adults locates the chief breeding season, depth, and locality with fair probability. Judging from the vertical distribution of this species off Gibraltar (p. 119) immigration from the Atlantic can not be invoked to account for its much greater abundance in the western basin in summer than in winter. And as the eastern basin does not support a large enough population to serve as a significant source of supply the only reasonable explanation is that the vernal increase in the western basin is the result of local reproduction. This points to an increase in breeding activity between February (month of the latest winter stations) and June, culminating before autumn. It is unlikely, on the other hand, that local reproduction in the eastern basin is sufficient to counteract the death rate, judging from the fact that *multicristata* is never generally numerous there. The occasional rich centers (p. 119) recorded there seem too sporadic to affect the population as a whole. The fact that the level of maximum abundance was no closer to the surface in summer, when the stock had been recruited from the new brood (or broods), than in winter, suggests that the juvenile stages occupy about the same strata as the adults.

Assuming that the difference between the "Thor" catches for January—February and for June September represents the normal variation in abundance between these two seasons, the summer -winter decrease points to an autumnal death rate of about 16 % of the summer population.

The richest catch was at the rate of 392 per hour or 352 per 5000 cubic meters of water.

## **LENSIA SUBTILOIDES** Lens and Van Riemsdijk (p. 58).

Fig. 77.

### Horizontal Distribution.

This species, first described by LENS and VAN RIEMSDIJK (1908) from the Malayan region, has subsequently been reported from the Indian Ocean (BROWNE, 1926) and in great abundance from the Great Barrier Reef, Australia (TOTTON, 1932). Most other recent authors (BIGELOW, 1913; MOSER, 1925; LELOUP, 1933, 1934) have considered this a synonym of *L. conoidea* (under the name *D. truncata*), so that it is impossible to learn from evidence now available, how widespread it really is.

The one "Thor" specimen was from the Bay of Biscay (Fig. 77).

## CHUNIPHYES MULTIDENTATA Lens and Van Riemsdijk (p. 60).

Fig. 77.

### Horizontal Distribution.

Records for this widespread species, originally described from Malayan waters (LENS and VAN RIEMSDIJK, 1908), include the Eastern Tropical Pacific (BIGELOW, 1911 b; 1931), the offing of California (BIGELOW and LESLIE, 1930), Eastern Sea between Japan and China (BIGELOW, 1913), Philippines (BIGELOW, 1919), and both sides of the Atlantic: south to South Georgia, and north to the Bay of Biscay (BIGELOW, 1911 a; MOSER, 1925; LELOUP, 1933, 1934; HARDY and GUNTHER, 1935). The fact that it was taken at 19 stations during the cruises of the Prince of Monaco between the Azores, Canaries, Straits of Gibraltar, coast of Portugal, and Gulf of Gascony (LELOUP, 1933), likewise by the "Thor" at two stations in the Bay of Cadiz, one off the coast of Portugal, and four in the Bay of Biscay, proves it generally distributed in this part of the Atlantic. But there is only one Mediterranean record for it (LELOUP, 1933, p. 39), the "Thor" having failed to find it at all there, in spite of the large number of deep tows made on her cruises (p. 3).

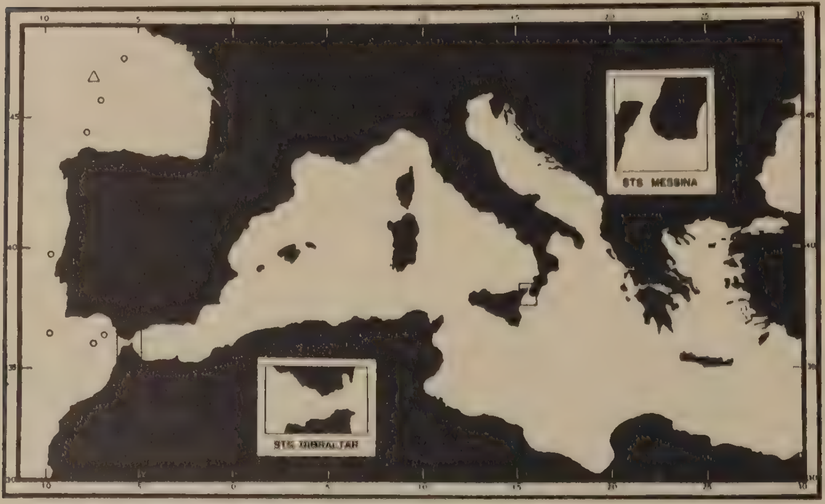

Fig. 77. "Thor" captures of *Lensia subtiloides* (triangle) and of *Chuniphyes multidentata* (circles).

The case of *Chuniphyes* is especially instructive as regards the problem of immigration into the Mediterranean (p. 128), both because records of it now include a considerable number of stations outside the Straits of Gibraltar, and also because it is so large, so characteristic in appearance, and so resistant in structure, that it would almost certainly have been recognized and recorded at many Mediterranean localities, if it occurred regularly there. Evidently, it passes the straits only as the rarest of stragglers, which do not long survive.

Table 50.

| Open hauls | | Closing-net hauls | |
|---|---|---|---|
| Depths between meters | Cases | Depths between meters | Cases |
| 450—0 and 650—0 | 8 | 500— 300 | 1 |
| 800—0 and 1200—0 | 4 | 600— 400 | 1 |
| 1500—0 and 1900 —0 | 5 | 800— 600 | 2 |
| 2000—0 and 2500—0 | 5 | 1000— 800 | 1 |
| 2650—0 and 3250—0 | 13 | 2280—1830 | 1 |
| 4500—0 and 4800—0 | 2 | 2740—1372 | 1 |
| | | 3660—1830 | 1 |

### Vertical Distribution.

Previous captures of *Chuniphyes* have been either in open nets sent to depths greater than 400 meters, or in closing-net hauls deeper than 300 meters, the distribution being as follows[1] (Table 50).

The "Thor" records again show *Chuniphyes* as chiefly confined to depths greater than

Table 51.

| Depth | No. of tows made at stations where Chuniphyes occurred | Percentage of tows taking Chuniphyes |
|---|---|---|
| 16 + 65 | 15 | 6 |
| 200 + 400 | 14 | 21 |
| 800 + 1033 | 4 | 100 |
| 2000 + 2866 | 2 | 100 |

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[1] This tabulation combines all published records of the species, for which the depth of the haul was stated.

200—400 meters, but as occasionally rising close to the surface, witness the capture of one nectophore in a haul with only 25 meters of wire, at Station 76, data being as given in Table 51.

The actual catches are listed on p. 60. The calculated vertical distribution of catches per hour (corrected) including all tows made (whether blank or productive) at the stations where the species occurred, is as follows (Table 52).

Table 52.

| Depths | St. 65 | St. 66 | St. 69 | St. 71 | St. 74 | St. 75 | St. 76 |
|---|---|---|---|---|---|---|---|
| 16 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| 43 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 200 | 0 | 0 | 0 | 5 | 0 | 0 | 0 |
| 400 | 0 | 0 | 0 | 57 | 53 | 0 | 0 |
| 800 | — | 8 | — | — | — | — | |
| 1033 | 2 | — | — | — | — | — | 74 |
| 2000 | — | — | 15 | — | — | — | — |
| 2866 | — | — | — | — | — | — | — |

## PHYSOPHORA HYDROSTATICA Forskål (p. 63).

Fig. 78.

### Horizontal Distribution.

*Physophora hydrostatica* has been recorded from the Indian Ocean (Quoy and Gaimard, 1834; Huxley, 1859; Haeckel, 1888), from the Malayan Archipelago (Lens and Van Riemsdijk, 1908), from the Philippines (Bigelow, 1913), from the Eastern Tropical Pacific (Bigelow, 1911 b, 1931), and from many localities in the Atlantic as far north as the Arctic Circle.

It has been reported at the following localities, in the Mediterranean:

Villefranche — Vogt (1854), Metschnikoff (1874), Moser (1917);
Nice — Risso (1826), Verany (1846), Vogt (1851, 1854), Leuckart (1854), Graeffe (1860), Claus (1860);
Naples — Delle Chiaje (1828), O. G. Costa (1836), Spagnolini (1868, 1870), Pavesi (1869...), Schmidtlein (1880), Bedot (1882), Schneider (1898), Lo Bianco (1899);
Messina — Philippi (1843), Kölliker (1853), Gegenbaur (1854), Sars (1857), Keferstein and Ehlers (1861), Claus (1878), Korotneff (1886), Cialona (1901);
Adriatic — off Lucietta, Pomo Deep, Southern Deep — Moser (1917).

The "Thor" did not take *P. hydrostatica* at any of the stations in the eastern basin, but found it at 11 stations in the Atlantic and in the western basin of the Mediterranean (Fig. 78). Of these, 4 were for winter, and 7 for summer showing that adult colonies occur the year-round, which is contrary to Chun's (1887, p. 16) earlier suggestion that the adults ripen at the beginning of winter.

### Vertical Distribution.

All records of *Physophora*, prior to 1887, were either at the surface, or close to the latter. In that year, however, Chun (1887, p. 16) described it off Naples (where it is common) as disappearing from the surface at the beginning of summer, and reported the capture of one young colony in a closing net, at 900 meters, in October. Subsequent records have again been from the surface and from hauls with open nets sent to various depths down to 900—0 meters.

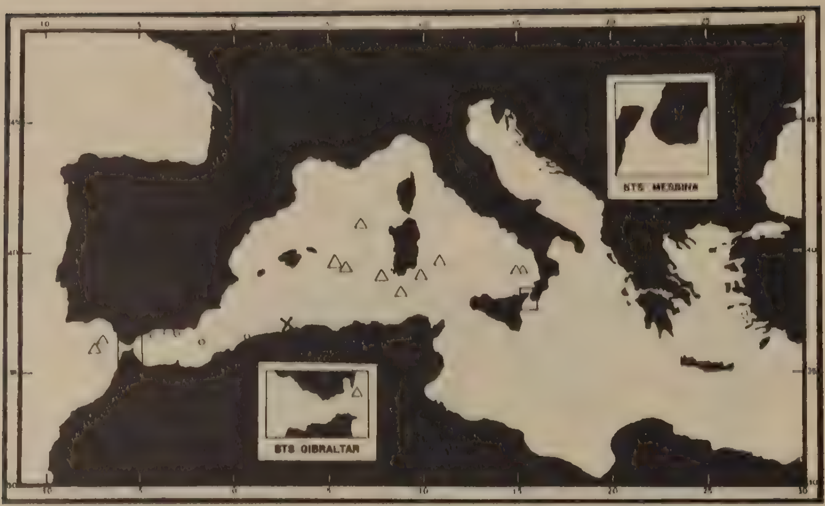

Fig. 78. "Thor" captures of *Physophora hydrostatica* (triangles), *Rhizophysa filiformis* (circles), and ?*Anthophysa rosea* (cross).

So far as they go, previous data thus suggested that the species lives chiefly in the upper strata, but that there is no definite lower limit to its occurrence. And this is corroborated — at least for the Mediterranean — by the fact that four of the six stems of *Physophora* taken by the "Thor" were in hauls from 43 meters (4 stations), one in a haul from 200 meters, one from 400 meters. Loose parts in other hauls were more widely distributed as to depth of capture, with palpons in one haul from 16 meters; one from 133 meters; one from 200 meters and nectophores in one haul from 16 meters; two hauls from 200 meters; one from 666 meters; and one from 800 meters. This suggests that these structures tend to sink if accidentally detached, as was to be expected.

## ? ANTHOPHYSA ROSEA (p. 64).

Fig. 78.

The single "Thor" capture is of considerable interest, geographically, for it is the first record for the genus in the Mediterranean.

It was, however, to be expected there, since the Prince of Monaco had it between the Azores and Canaries (Bedot, 1904, p. 5, *Anthophysa formosa*).

## RHIZOPHYSA FILIFORMIS Forskål (p. 65).

Fig. 78.

### Horizontal Distribution.

The few "Thor" records (Fig. 78) add little to the geographic range of this warm-water species, for it was known, not only from various localities in the Tropical and Subtropical Atlantic, from the Malaysian region, and from the Eastern Tropical Pacific, but from the following west-Mediterranean localities as well:—

Nice — Risso (1826), Leuckart (1853);
Naples — Spagnolini (1868, 1870), Korotneff (1884), Schmidtlein (1880), Schneider (1898), Lo Bianco (1889), Neppi (1921);
Messina — Sars (1857), Gegenbaur (1854), Keferstein and Ehlers (1861);
Villefranche — Vogt (1851), Fewkes (1879).

So far the only record for it in the eastern basin of the Mediterranean is in the Gulf of Corinth ("Thor" St. 184).

### Vertical Distribution.

The vertical distribution of the "Thor" specimens (7 colonies distributed among 5 hauls from 16, 43, 56, and 1333 meters) is in line with previous experience, this species having been taken frequently at the surface and also in hauls with open nets from various depths. It is probable that it occurs most frequently in the upper 100 meters or so but that, on occasion, it may live much deeper.

The "Thor" captures added to the early records show that *R. filiformis* may be expected in the Mediterranean at any time of year.

### **PORPITA UMBELLA** O. F. Müller (p. 66).

Fig. 79.

#### Horizontal Distribution.

*Porpita* is a regular inhabitant of the Mediterranean. Earlier records are:—

Mediterranean — Eschscholtz (1829);
Cette, Nice, or Specia — Pagenstecher (1869);
Nice — Verany (1846), Leuckart (1854);
Villefranche — Leloup (1935);
Genoa — Verany (1846);
Naples — Spagnolini (1868, 1870), Schmidtlein (1880), Bedot (1882), Korotneff (1884), Schneider (1898), Lo Bianco (1899), Neppi (1921);
Messina — Kölliker (1853), Gegenbaur (1854), Keferstein and Ehlers (1861), Cialona (1901);
Malta — Forskål (1775);
Lycia — Forbes (1844).

These, and the "Thor" captures (Fig. 79) show that its range includes both basins, as well as the channel connecting them.

The records of *Porpita* in the Mediterranean are fewer than for *Velella* and it seems never to be as abundant there, although Schneider (1898) reports occasional swarms off Naples, while Lo Bianco (1899) notes that it often appears in great numbers there, during the summer. The season of greatest abundance at Messina is reported as May (Cialona, 1901). Most of the other records have also been for spring and summer.

The breeding season appears to endure from late spring to fall judging from Lo Bianco's (1899) report of the liberation of medusae from May to June and October, with young colonies of 5 mm. in July. This is corroborated by the fact that the "Thor" specimens all of which were small (p. 66) were taken in late summer.

### **VELELLA VELELLA** Linné (p. 66).

Fig. 79.

#### Horizontal Distribution.

This well known species is widespread in the western Mediterranean, as appears from the extensive list of published records:—

Mentone — Forskål (1775), Hollard (1845);
Cette — Granger (1879);
Cette, Nice, or Specia — Pagenstecher (1869);
Nice — Risso (1826), Verany (1846), Vogt (1854), Leuckart (1854), Bedot (1894);
Monaco — Moser (1917), Boone (1933);
Villefranche — Bedot (1884), Woltereck (1905), Moser (1917, 1925), Leloup (1935);
Genoa — Verany (1846), Pavesi (1869...);
Livorno — Spagnolini (1876);
Capri — Lo Bianco (1903);
Naples — O. G. Costa (1836), Sars (1857), Keferstein and Ehlers (1861), Spagnolini (1868, 1870), Pavesi (1869.,.), Schmidtlein (1880), Bedot (1882), Korotneff (1884), Schneider (1892, 1898), Lo Bianco (1899), Neppi (1921), Moser (1925);

Palermo — De Gregorio (1892);
Messina — Kölliker (1853), Gegenbaur (1854), Cialona (1901), Moser (1925);
Trieste — Graeffe (1884);
Rhodes — Forbes (1844).

The presence of *Velella* at any particular locality within its range, is largely fortuitous, as it is blown to and fro by the wind. Up to date, Forbes' record is the only one for the eastern basin, all the "Thor" records being from the western basin west of 5° W. (Fig. 79).

*Velella* is the most widespread and numerous of the Chondrophorae in the Mediterranean, tremendous swarms often appearing suddenly, in such numbers as to litter the shore (Granger, 1879) or as to become a pest in small harbors (Moser, 1917, p. 706). It also appears at all seasons, having been recorded in October (Keferstein and Ehlers, 1861), in spring (Moser, 1917, Leloup, 1935), May (Hollard, 1845, Leuckart, 1854), June (Granger, 1879), and by Woltereck (1905) throughout the year. The "Thor" records are for summer.

Some indication that spring is the season of most frequent occurrence is to be gained from various lists. That kept at Villefranche from 1899—1913 (Moser, 1917) — perhaps the most complete — shows a preponderance in April, May, and June; that for Messina (Cialona, 1910) records it in May. Spagnolini (1870), however, reports many individuals in January 1865, 1867, in November 1866 and in March, 1867.

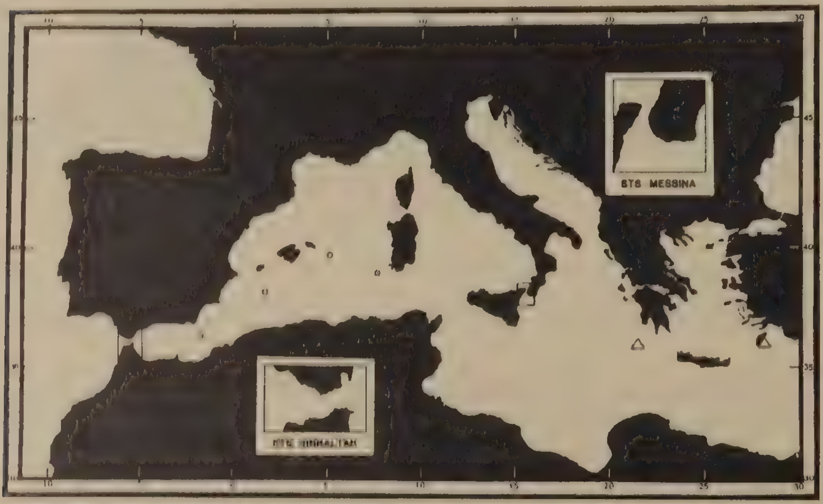

Fig. 79. "Thor" captures of *Porpita umbella* (triangles) and *Velella velella* (circles).

Though Woltereck (1905, p. 110, footnote) states that the larvae occur at great depths (1000 meters or more), he failed to record the season. But Lo Bianco (1899) noted buds and Chrysomitra at Naples from October to December and from April to June. Further he (1903) recorded juveniles and very young specimens from February to April in the waters about Capri, and Leloup (1935) reports the larvae at Villefranche in March.

## SIPHONOPHORE FAUNA OF THE MEDITERRANEAN COMPARED WITH THAT OF THE ATLANTIC.

The unity of the marine fauna of the Mediterranean with that of the neighboring parts of the Atlantic is now well established. But certain interesting differences remain to be accounted for. And knowledge of the distribution of the siphonophores has so greatly expanded, within the past few years, that a resumé of present information seems timely.

As a starting point, we may take Chun's (1897) discussion in which he pointed out that, while most of the siphonophores known at that time in the Mediterranean had also been found outside the Straits of Gibralter several of the species most widespread in the neighboring parts of the Atlantic, and others recorded from the Straits of Gibraltar, had never been seen in the Mediterranean, though the siphonophores had been more intensely studied there than anywhere else. His list of species, supposedly characteristic of the Atlantic included the following (as they are now named):— *Diphyes dispar*, *Diphyes bojani*, *Abylopsis eschscholtzii*, *Abyla trigona*, *Bassia bassensis*, *Enneagonum hyalinum*, *Ceratocymba saggittata*, *Agalma okeni*, *Athorybia rosacea*, and *Rhizophysa eysenhardtii*.

At that time, on the other hand, the following Mediterranean species were not yet known from the Atlantic:— *Galetta turgida* Gegenbaur, *Lensia conoidea* Keferstein and Ehlers, *Clausophyes ovata* Keferstein and Ehlers, *Stephanomia rubra* Vogt, *Agalma clausi* Bedot, and *Lynchnagalma utricularia* Claus.

Since that time the picture has been altered radically. Thus, *Stephanomia rubra* has been found in the Western Atlantic (BIGELOW, 1918, p. 426); *Clausophyes ovata* has been found at numerous localities in both the North and South Atlantic (MOSER, 1925; LELOUP, 1933, 1934) as well as in the Northwestern Pacific (BIGELOW, 1913); *Lynchnagalma utricularia* is to be expected in the Atlantic because a form almost certainly identical with it has been found in the Tropical Pacific[1]; the status of *Galetta turgida* is doubtful, and *Agalma clausi* has not been seen since the year 1888. In short, it becomes increasingly unlikely that the Mediterranean harbors any species of siphonophore (or of any other planktonic group of animals) which is peculiar to it, or even any which have its chief center of abundance there[2].

CHUN's (1897) list of supposedly "Atlantic" species has similarly suffered reduction, *Enneagonum hyalinum* (p. 20), *Ceratocymba sagittata* (p. 28), *Abylopsis eschscholtzu*, *Bassia bassensis* (p. 26), *Diphyes dispar* (p. 40), *Diphyes bojani*, *Agalma okeni*, and *Athorybia rosacea* having all been found in the Mediterranean. But all eight except the last of these (which has seldom been seen anywhere) certainly occur much less regularly there than in the Central Atlantic.

There still remains the following list of species known from one locality or another in the warm zone of the Atlantic between latitudes 30° S. and 40° N., or in the Straits of Gibraltar, but which have not yet been found in the Mediterranean, though it is, of course, possible, that any or all of them may eventually be discovered there as MOSER (1917, p. 716—720) has remarked. About half of these have been discovered since CHUN wrote.

*Heteropyramis maculata* Moser
*Nectopyramis thetis* Bigelow
*Mitrophyes peltifera* Haeckel
*Rosacea tuberculata* Moser
*Rosacea intermedia* Leloup
*Abyla quadrata* Moser
*Abyla haeckeli* Lens and Van Riemsdijk
*Abyla trigona* Quoy and Gaimard
*Abyla leuckartii* Huxley
*Sulculeolaria monoica* Chun
*Galetta chuni* Lens and Van Riemsdijk
*Conophyes diaphana* Leloup
*Chelophyes contorta* Lens and Van Riemsdijk
*Eudoxoides mitra* Huxley
*Dimophyes arctica* Chun
*Hippopodius cuspitatus* Moser
*Vogtia serrata* Moser
*Nectalia loligo* Haeckel
*Erenna richardi* Bedot
*Rhodalia miranda* Haeckel
*Angelopsis globosa* Fewkes
*Rhizophysa eysenhardtii* Gegenbaur
*Pterophysa*
*Salacia uvaria* Fewkes
*Porpema globosa* Eschscholtz

and also the following eudoxids of problematical parentage:—

*Eudoxia russelli* Totton
*Eudoxia problematica* Moser
*Eudoxia galathea* Moser
*Eudoxia tottoni* Leloup

Numerically, this list is formidable, considering how few species of siphonophores exist. And while a considerable proportion are either known from a single catch or have been taken so seldom anywhere, that locality records of their occurrence are best omitted from the discussion of regional relationships, some of them — notably *Eudoxoides mitra* and *Dimophyes arctica* — are both common and widespread outside the Straits of Gibraltar. In short, it still appears that while there is no sharp distinction between the siphonophore faunae on the two sides of the Straits of Gibraltar, that of the Mediterranean is characterized by some qualitative poverty, as contrasted with that of the open Atlantic; a poverty that embraces not only the bathyplanktonic category, but also the shoaler-living communities as well.

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[1] *Lynchnagalma vesicularia* (Haeckel, 1888b).

[2] According to SCHNEIDER (1898) all the named species of *Forskalia* which have been reported from the Mediterranean are identical with forms also known from the Atlantic. But, as previously remarked (BIGELOW, 1911b, p. 270), it is idle to discuss these, until well preserved series of the genus have been reexamined.

It will, we think, be agreed that one key to the situation lies in the submarine topography and prevailing circulation in the Straits of Gibraltar. CHUN (1897) long ago emphasized the fact that the shoalness of the Straits would necessarily impose a barrier to the passage of any pelagic animal which lived deeper than the sill depth, which according to recent soundings is not greater than 300 meters (DE BUEN, 1934). And the prevailing drift of the undercurrent outward may be expected to emphasize this barrier to inward migration.

Obviously, the efficiency of this mechanical obstacle will depend on the depth of the upper limit to the normal occurrence of any species in question. And it is necessary to consider each separately (not to group them into artificial categories). Among Atlantic siphonophores, a number of species have been described by one author or another as characteristic of depths considerably greater than the sill depth of the Straits. But the records of recent expeditions leave only *Nectopyramis thetis*, *Heteropyramis maculata*, and the genera *Bathyphysa*, *Pterophysa*, and *Erenna* as still known only from tows (or entangled on the wire) which reached down deeper than 400—500 meters.

As none of these have ever been taken inside the Mediterranean (except for BEDOT's (1904, p. 15) record of *Bathyphysa grimaldii* just inside the Straits), we can assume, either that the barrier is absolute for them, or that such specimens as may occasionally be carried in across it meet conditions so unfavorable that they shortly perish, without leaving descendants in the deep strata of the Mediterranean. In this, they correspond to *Atolla bairdii* among the Medusae (KRAMP, 1924), to various representatives of the Pygmaeidae, Lanceolidae, Thaumatopsidae, Scinidae, and Vibilidae among the hyperiid-amphipods (STEPHENSEN, 1926, p. 241), to certain penaeids among the decapods (STEPHENSEN, 1923) and to certain euphausiids (RUUD, 1936).

A few other species, namely, *Chuniphyes multidentata*, *Clausophyes ovata*, *Vogtia serrata*, *V. pentacantha*, *V. spinosa*, *V. glabra*, and *Rosacea plicata*, can also be described as primarily bathypelagic, because most of the records have been from tows which sampled the plankton down to at least 250 meters. But apparently they rise into the upper strata more often than do the *Erenna-Bathyphysa* group, for each of them has been taken occasionally close to the surface. All the members of this group are known from the Mediterranean; and two at least of them (*Vogtia pentacantha* and *V. spinosa*) are not uncommon there, in the deeper strata.

The vertical distribution of the "Thor" catches of *Chuniphyes* in the Bay of Cadiz in the winter of 1909 in relation to the hauls made there (p. 123) is especially suggestive in this connection for it shows that if this species occurred at all in the upper strata in the offing of the Straits, it was at least so rare there that none were picked up, in contrast to the abundant representation at depths greater than, say, 1000 meters. So long as individuals remain as deep as this, the threshold of the Straits obviously presents an impassable barrier. But experience has repeatedly shown that bathypelagic animals are from time to time carried upward, even right to the surface, by circulatory movements. And it is certain that the normal vertical range of *Chuniphyes* does extend upward at other times and places to a level from which this would be much more likely to occur than the Bay of Cadiz records might suggest: witness captures at 300—0, 400—0, and 500—0 meters in the Bay of Biscay (BIGELOW, 1911 a, also "Thor" St. 71, p. 60) and one at 25—0 meters ("Thor" St. 76). Even if it be exceptional for any particular bathypelagic animal to rise directly within the influence of the inflowing surface current, the presence of the outflowing bottom current is not as effective a bar at the 200—300 meter level, as might appear, for the drift may become slack, or even temporarily reversed at times when the water is piled up in the eastern Mediterranean by prolonged westerly gales (NIELSEN, 1912, p. 171). Deep

Atlantic water may thus work its way inward, in eddies and swirls and so finally bring its bathypelagic fauna within the sweep of the easterly drift. Thus it is not surprising that some of the inhabitants, even of great depths, pass in through the Straits, even though we have no evidence that any mass-immigration from this source was taking place at the times of the "Thor" cruises.

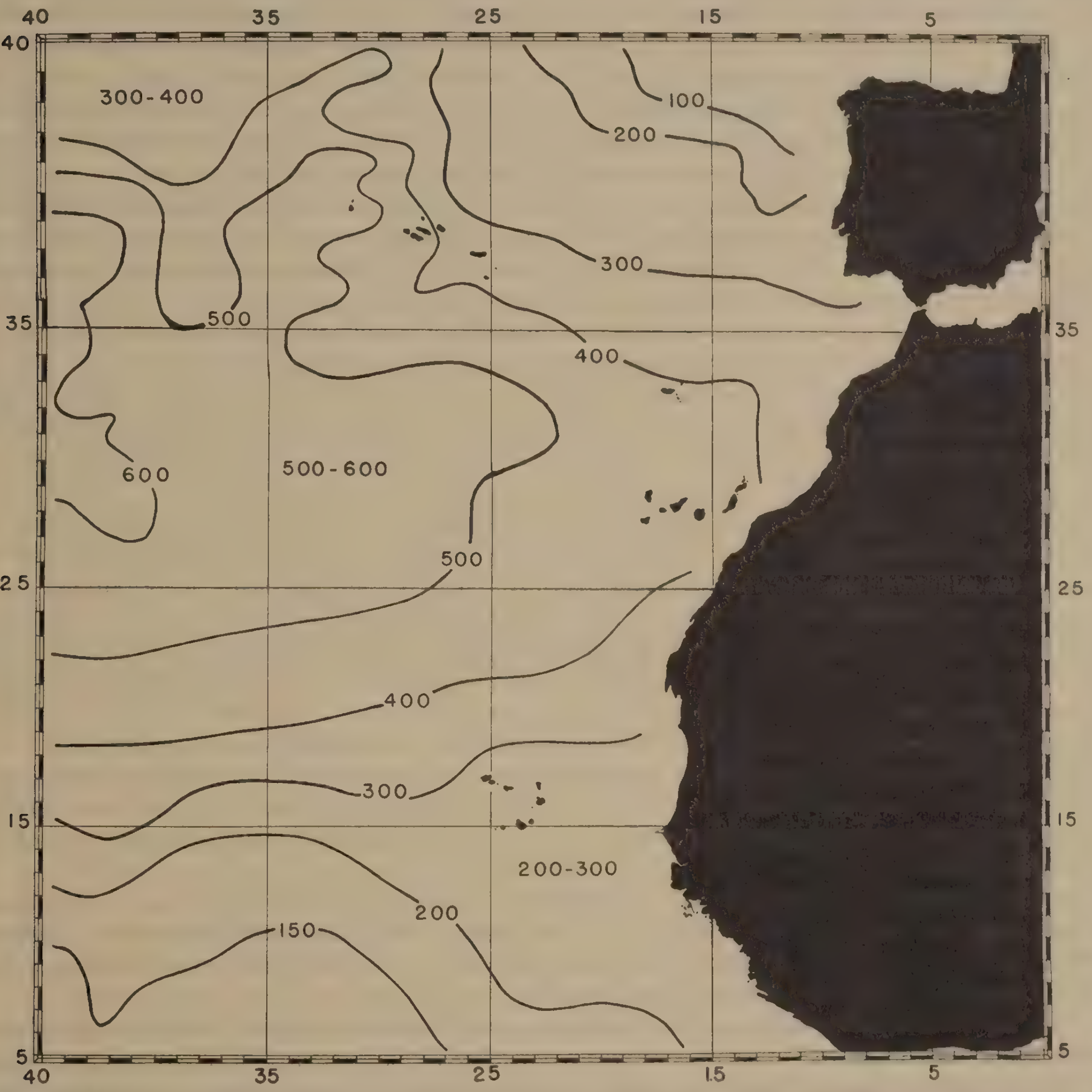

Fig. 80. Mean depth in meters, of the isothermobath of 12.5° C. in the eastern Atlantic, in the general offing of the Straits of Gibraltar, based on combination of available data.

However, the number of individuals of any species of bathypelagic siphonophore so entering, is not likely to be great. And the water-masses with which they pass through the narrow portal of the Straits are so greatly diluted by mixture, immediately within the latter, that the immigrant population at any given time may well be so sparse (even in the immediate vicinity) as never to rise above the minimum density which would be needed for the maintenance of a local stock, for the particular animal in question. Furthermore, the differential circulation must, at the same time, tend to carry them out again, for their chance of rising within the sweep of the outflowing bottom-drift inside the Straits, would seem more imminent than of rising high enough, outside, to be caught in the shoaler inflowing surface drift. And even if immigrants of this category ever do enter in numbers, and if they, or their immediate descendents do not chance to be swept out again, the high temperature and high salinity they must meet, when they again sink, in the Mediterranean, to the depths where they normally live, may well present a problem in adaptation so serious as to prevent the development of a permanent community:— not so much by discouraging their access, as JESPERSEN (1915) suggests may happen for certain fishes, but by abbreviating the survival of specimens which enter.

*Chuniphyes* for example, lives chiefly in salinities of 35.5—36.0 ‰, at its normal depth-range in the open oceans, but would encounter water of 37—38 ‰ in the western basin of the Mediterranean, of 38.5 ‰ and higher, in the eastern. This increase may well be unfavorable, though it must be admitted that as yet, nothing definite is known as to the salinity relationship of any siphonophore.

No general rule can be stated as to whether transfer from outside the Straits to inside, would involve a serious shift of temperature, even for bathypelagic species (i. e., those living chiefly deeper than 300—400 meters), for this would depend on the precise depth of the upper boundary of their usual occurrence in the oceans. Thus, the isothermobath for 12.5° (the whole mass of deep water in the Mediterranean is 12—13°) which lies at about 350 meters in the Bay of Cadiz ("Thor" St. 69) sinks to about 450 meters near Madeira (Fig. 80).

In the case of *Chuniphyes* (the bathypelagic siphonophore for which the most extensive information is available) the maximum temperatures for catches so far made in closing nets[1] have been between 4.4° and 9.2°, the minimum, possible, for these same hauls, 2.2° and 7.1°. And the highest temperatures in which the presence of more than an odd *Chuniphyes* has ever been established, are 10.6°, 11.1°, and 11.8°.[2] This, added to the frequency with which *Chuniphyes* has been taken, in various parts of the world in hauls which have reached down to depths where the temperature was lower than 5—10°, strongly suggest that its usual habitat is colder than 10° C., with the lower limit certainly as low as 4° C. and very likely as low as 2° C. The deep Mediterranean may thus be unfavorably warm for it, even though not immediately fatal. And it is not unreasonable to assume that this applies perhaps even more strongly to *Nectopyramis*, *Erenna*, *Nectalia*, *Bathyphysa*, and *Pterophysa*, judging from the fact that various bathypelagic animals have repeatedly been proven by experiment, to be extremely sensitive to temperatures only slightly above those from which they have been brought up.

The combination of the shoalness of the Straits, with the differential circulation prevailing there, and the hydrologic characteristics of the deep water of the Mediterranean, thus, combines against free population of the latter, from the deeps of the Atlantic. And there is certainly no evidence that any bathypelagic animal, of any group, has originated within the Mediterranean.

In the case of planktonic animals which range upward toward the surface, or which live chiefly in the upper 100—200 meters, the situation as regards access to the Mediterranean, differs from that just outlined, for the prevailing system of currents must effect constant interchange between Atlantic and Mediterranean, specimens living shoalest drifting inward through the Straits, but those living 50—100 meters down, drifting outward. And it is now well established that the vertical ranges of the great majority of the siphonophores of the upper waters do extend down indifferently at least as deep as this. The only notable exceptions so far known are *Velella*, *Porpita*, *Physalia*, and *Porpema*; the first three of which are well known in the Mediterranean, while the only records of the latter in the western hemisphere are, one from the South Atlantic (Haeckel, 1889), and one from near the Cape Verde Islands (Eschscholtz, 1829).

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[1] Three in the Bay of Biscay from 2740—1370 meters, 2100—1370 meters, and 366—1830 meters (BIGELOW, 1911 a); also 4 "Meteor" hauls in the Atlantic from 800—1000 meters, 600—800 meters; 400—800 meters, and 400—600 meters (LELOUP and HENTSCHEL, 1935).

[2] "Research" hauls from 457—0 meters and 574—0 meters in the Bay of Biscay (BIGELOW, 1911 a) and 300—0 meters at "Thor" St. 71 (p. 60).

To illustrate the efficiency with which the prevailing inward current, via the Straits may populate the Mediterranean with planktonic animals produced in the Atlantic, we need merely quote the example of the larvae of the common eel (*Anguilla anguilla*).

In short, there would be every reason to expect such siphonophores as *Diphyes dispar*, *Diphyes bojani*, *Eudoxoides mitra*, *Lensia subtilis*, and *Abylopsis eschscholtzii* to appear in the Mediterranean with much greater regularity than appears to be the case, if conditions were favorable for their existence there, and if they occurred in the immediate offing of the Straits in anything like the abundance they do in the Azores-Canaries region. The most extensive sources of information available on the latter point (additional to the "Thor" records) are the Station records of the cruises of the Prince of Monaco (Leloup, 1933, p. 42; Richard 1934), during which about 225 open-net tows, that might have been expected to catch siphonophores were made in the general region between the Straits and Longitude 15° W., during the years 1885—1914. These yield the following data, for the group of species in question:—

a) *Diphyes dispar*, total Atlantic catches, 41 of which only one was between 15° W. and the Straits in that general area;

b) *D. bojani*, total Atlantic catches, 14; catches between 15° W. and the Straits in that general area, 1;

c) *Lensia subtilis*, no "Monaco" records;

d) *Eudoxoides mitra*, total Atlantic catches, 8; catches between Longitude 15° and the Straits, 0;

e) *Dimophyes arctica*, 2 stations near the Azores and southward;

f) *Abylopsis eschscholtzii*, total Atlantic catches, 26; catches between 15° W. and the Straits, 0.

The poverty of the region just off the Straits, is still further emphasized if one considers the comparatively frequent occurrence farther south and west of such species as *Dimophyes arctica*, *Eudoxoides mitra* and *Lensia subtilis* (Moser, 1925; Leloup and Hentschel, 1935) of which the "Monaco" cruises obtained only a sparse representation.

All this contrasts very strongly with the distribution of the Prince of Monaco's catches of *Chelophyes appendiculata* (common in the Mediterranean), 105 Atlantic catches of which 25 were in the vicinity of the Straits, east of Long. 15° W. *Abylopsis tetragona*, also, though taken at only 6 Atlantic "Monaco" stations, was found twice in the area in question.

In short, the problem, as regards the shoal living siphonophores is not only one of Mediterranean versus Atlantic, but equally why a whole category of species, which are very common either in the Canaries-Azores region, or farther west or south, appear so seldom, either in the Mediterranean, or even in the superficial 200—300 meters in the parts of the Atlantic from which immigration into the latter must draw most directly.

From this standpoint, it is natural to think first of temperature. And it will, we believe, be accepted without argument, that no animal acclimated to temperatures lower than, say, 10° C. could permanently exist shoaler than about 500 meters in this latter region, for even in mid-winter, the 300 meter level, immediately off the Straits does not cool below 12.5° C.; or below 13° C. anywhere in the Mediterranean.

The earlier view (Bigelow, 1911 b, p. 369) that *Dimophyes arctica* fell in this category, i. e. was barred from the Mediterranean by the high temperature of the latter, seemed to Moser (1917; 1925) contradicted by its capture by the "Gauss", in hauls from mid-depths at a number of stations through the South Atlantic, even actually at the surface at the Cape Verdes, near the Equator, and at Port Natal, Southeast Africa. But analysis of the "Gauss" hauls which yielded it, does not accord with her conclusion (Moser, 1925, p. 394) that its distribution is wholly independent of temperature, for the great majority of captures may have been in water colder than 10° C. and most of them (Antarctic) certainly were from temperatures lower than 2° C.

The "Meteor" records (Leloup and Hentschel, 1935) give still more definite evidence, in the same direction, for while one catch was certainly from water as warm as 22° C. (St. 174, 21°30′ S., 15°36′ W.,

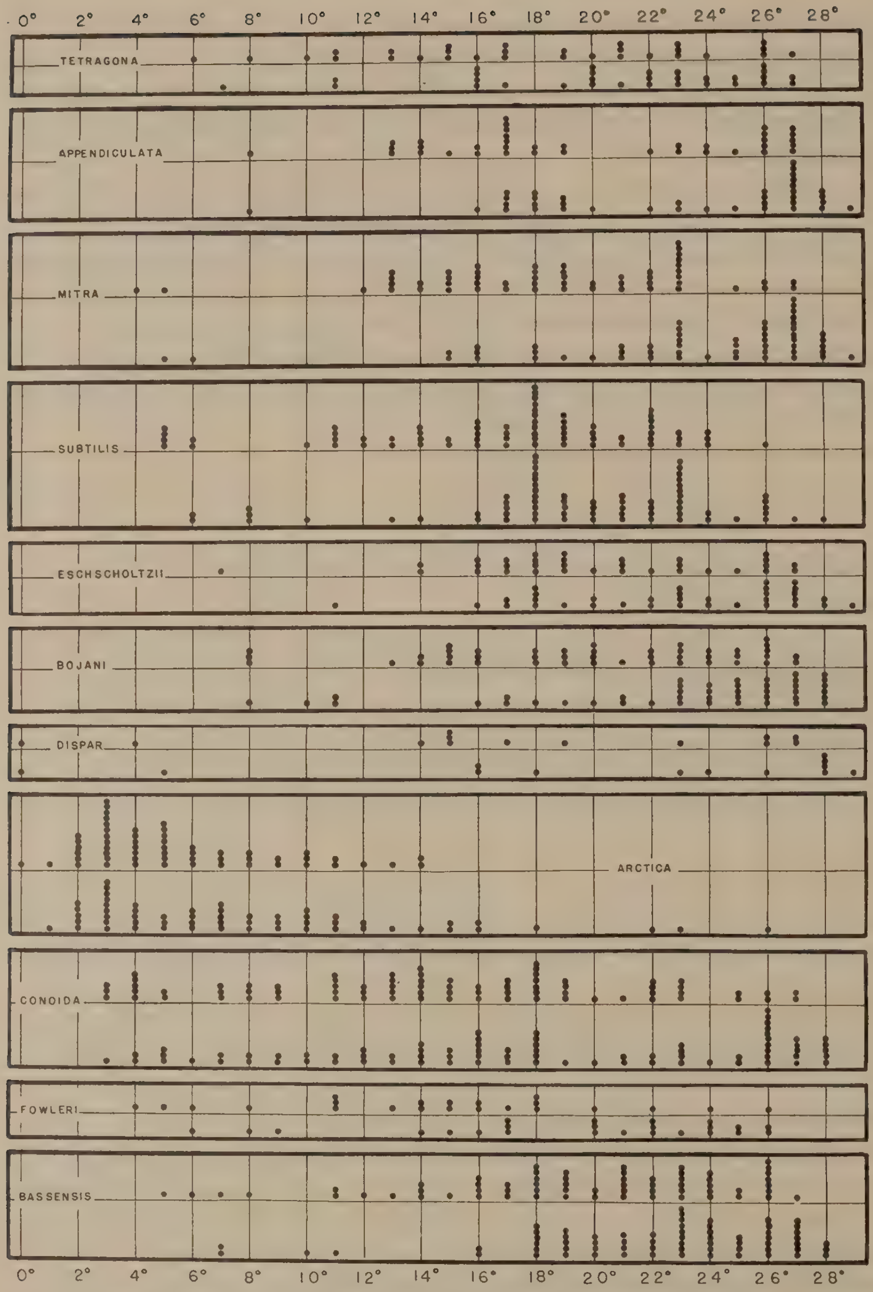

Fig. 81. Frequency-distribution of upper and lower limits of temperature, for "Meteor" closing net hauls that yielded the species named in the diagram, from data by Wüst (1932) and Leloup and Hentschel (1935); hauls that covered more than a 10° range of temperature are omitted from the calculation. For each species, the number of dots in the upper row equals the number of cases in which the indicated temperatures were the minimum (according to the depth limits of the hauls), in which the specimens could have been taken. The dots in the lower row show the number of cases in which the indicated temperature was the maximum possible for the same group of hauls.

0—100 meters), the great majority were equally certainly from <16° C. and 75% of them from < 11° (Fig. 81), partly because so far south and partly because of depth. Present indications therefore are that while *D. arctica* is cosmopolitan, so far as latitude is concerned, and while it may occasionally rise to the surface even in the tropics, as it does regularly in cold latitudes, it is much more abundant in the subantarctic and subarctic than anywhere between, and the great majority of the stock existing in mid- and low latitudes are so deep down in the water that they are living at temperatures lower than 12° C. Under these circumstances, the occasional discovery of odd specimens near the surface, in warm seas, does not imply the ability to survive, much less to multiply there. Recent evidence tends, on the contrary to corroborate the earlier view that the whole vertical column, throughout the Mediterranean is too warm for the existence of a permanent population of this species; and (assuming the optimum to be less than 11° C.) this applies equally to the upper 500 meters off the Straits of Gibraltar.

It is interesting to compare the thermal status of *Dimophyes arctica* with that of *Lensia conoidea*, from the present point of view, because Moser (1917, p. 719) has laid stress on the apparent agreement between the two, in their vertical and latitudinal distribution. However, the "Meteor" data show a very strong contrast, for while the captures of *D. arctica* were definitely concentrated in temperatures lower than 12° (Fig. 81), those of *L. conoidea* were very evenly distributed over the whole range of temperature, between 3° and 26—27° C., proving that this species is in fact, wholly independant of temperature. And the temperature-distribution for *Lensia fowleri* shows a similarly wide distribution (Fig. 81) in the upper range which corresponds to the fact that both *conoidea* and *fowleri* are not only regular inhabitants of the Mediterranean, but occupy the whole depth range there, from 100—200 meters downward for *fowleri* and from 50 meters, downward, for *conoidea* (p. 113).

Nor is it likely that any other siphonophore, inhabitating the upper 100—200 meters of the North Atlantic, would find the Mediterranean too warm for year-round existence, for while the distribution records — taken at face value — might suggest that this would apply to *Stephanomia cara* Agassiz, it is probable that this supposed species will prove identical with a form (*S. bijuga*) which has long been known from the Mediterranean, as well as the warm zones of the oceans.

The case is not so clear, as regards the possibility that winter temperatures in the Mediterranean may be unfavorably low, for species that are common in the Subtropical Atlantic, but are absent from the Mediterranean or that are only sporadic in their appearance there. This possibility was long ago suggested by CHUN (1897). And knowledge of the distribution of siphonophores, as it stood in the early years of the present century, seemed to justify definite conclusion that such is the case (BIGELOW, 1911b, p. 375). But subsequent discovery that most of the species supposedly characteristic of the Tropical Atlantic also occur in the Mediterranean (making it likely that all of them will eventually be found there), and that most of them live in comparatively low temperatures as well as in high, lead MOSER (1917, 1925) to decide, on the contrary, that it is not low temperature that is responsible for the scarcity in the Mediterranean, of any general category of siphonophores. In her view, "das Problem selbst nur an Schwierigkeit gewonnen hat durch den Nachweis, dass die Beziehungen der Siphonophorenfauna des Mittelmeeres zu der des Atlantik viel engere sind und die getroffene Auswahl dadurch noch merkwürdiger ist als es zu CHUN's Zeiten den Anschein hatte" (MOSER, 1917, p. 720).

Analysis of the catch records of the "Meteor" (LELOUP and HENTSCHEL, 1935) corroborate her conclusions, to the extent that we certainly have not to do with a sharp-cut case of temperature control; but at the same time, it strengthens the view that low temperature may still be one of the factors in the case. As most of the "Meteor" catches were made either in vertical open-net hauls from small depths, or in closing nets operated through short vertical distances, the upper and lower limits of temperature between which the specimens in question were living can be definitely determined in most cases to within 10° C., often within 2—3° C. The distribution is as follows[1], for the common Atlantic species that are found only occasionally, or not at all in the Mediterranean.

a) *Diphyes bojani* (Fig. 81), total proven range, 8°—27° C.; 85% certainly from > 15° C., 60% from 20° C. or warmer..

b) *Diphyes dispar* (Fig. 81), proven range, 0°—27° C.; 85% certainly from > 15° C.; 70% from 20° or warmer.

c) *Lensia subtilis* (Fig. 81), proven range, 6°—26°; 72% certainly from > 15°, 30% from 20°, or warmer.

d) *Eudoxoides mitra* (Fig. 81), proven range, 5°—27°; 72% certainly from > 15°, 41% from 20° or warmer.

e) *Abylopsis eschscholtzii* (Fig. 81), proven range; 10°—27°; 91% certainly from > 15°, 50% from 20° or warmer.

f) *Bassia bassensis* (Fig. 81), proven range, 7°—27°; 81% certainly from > 15°, 53% from 20° or warmer.

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[1] Only those hauls are considered where the upper and lower limits of temperature were less than 12° C. apart.

And Totton's (1932) records, for the Great Barrier Reef region, show that *L. subtilis* can support a temperature as high as 26—27°; *E. spiralis* even as high as 28°; while the other species named above may have been living there in water as warm as 27—29°.

If these distributions, with the obvious concentrations in the upper temperature range shown by the graph (Fig. 81) were the only evidence available, they would indicate that while any one of this group of species, may occasionally sink so deep, or stray so far south (or north) as to come within arctic temperatures, the winter chilling in the Mediterranean (to 12.40°—14.50°) might well be unfavorable enough to prevent the maintenance of an abundant year-round population. It appears, however, — so far as the "Meteor" data go — that precisely this same argument could be applied to *Chelophyes appendiculata*, which is actually the most nearly universal, and most abundant siphonophore, not only in the Mediterranean (winter and summer), but likewise in the Bay of Biscay (Bigelow, 1911 a), for the temperature distribution of the "Meteor" catches of it were as follows: proven range, 0°—27°; 85 °/₀ certainly from > 15°; 40 °/₀ from 20° or more. And while the "Meteor" captures of *Abylopsis tetragona* show more scattering toward low temperatures (Fig. 81), they were, likewise, concentrated chiefly above 12°—13.

Here we must let the question rest until more definite information comes to hand regarding the temperature-relations, and especially the breeding temperatures, of the various species. The most that can be said at present is that available evidence still seems to support the view that low winter temperature may act in some way as one of the factors responsible for the poverty of the calycophore-fauna of the Mediterranean, as regards certain tropical species, whereas other species, e. g. *C. appendiculata*, appear to be more tolerant in this respect, though equally at home in tropical temperatures in the Atlantic.

The possibility must also be taken into account, that local races of siphonophore species may exist, indistinguishable morphologically but with different temperature-optima, just as is now known to be true of various fishes. And it is suggestive, in this connection, that three surface forms, *Porpita*, *Velella* and *Physalia*, which are usually regarded as reliable tropical indicators in the opposite side of the North Atlantic, are so widespread in the Mediterranean (p. 135).

What role, if any, the high salinity of the Mediterranean may play here, is a matter about which absolutely nothing is known. We need only point out that there is no question of low salinity acting as a bar, as it apparently does in the Lagoon of the Great Barrier Reef at certain times of year (Russell and Colman, 1935, p. 269).

## WESTERN AND EASTERN BASINS OF THE MEDITERRANEAN.

The "Thor" collections allow the first comparison of the siphonophore fauna of the open waters of the western basin of the Mediterranean with that of the eastern, so making it at last possible to test the widespread idea that the former supports a much more abundant population of pelagic coelenterates than does the latter. This view first found expression by Forbes (1844, p. 147), who speaks of the scarcity of "acalephous animals" in the Aegean, and comments that "though continually on the look-out for these beautiful creatures only fifteen species were met with", adding that "the sheltered bays of Asia Minor and the squally seas of the Cyclades were alike unprolific" and that "of the *Physograda* [Siphonophores], several examples of a large *Stephanomia* were met with in the Gulf of Macri", and "of the *Diphydae* occasional individuals were seen", while "*Velella spirans* was collected by Lieut. Spratt on the shore at Rhodes, in December, 1842, and *Porpita glandifera* occurred once on the sandy shore between Patara and the mouth of the Xanthus". Generalizing, he added of the "Medusae" as a whole that "they abound near the gut of Gibraltar, a locality prolific in species as well as individuals. Their numbers decrease as we approach the shores of Greece. In the Aegean, as we have seen, they play an unimportant part".

Moser (1917) within recent years, has emphasized the poverty of the siphonophore fauna of the Adriatic, near Trieste, where the successive studies of Will (1844), Busch (1851), Claus (1878), von Graeffe

(1884), and Stiasny (1910, 1911) had increased the list of species only to 7, contrasting strongly with the much more varied and more abundant siphonophore populations which had long been known to exist in the Straits of Messina, in the Bay of Naples, and in the vicinity of Nice and of Villefranche along the northwestern shores of the Mediterranean. And while Moser (1917) herself was able to add 13 more species from the Adriatic, the total list, then known from the eastern half of the Mediterranean was still less than half as numerous as for the western.

It is, however, to be noted that all the systematic studies of siphonophores in the eastern Mediterranean, so far mentioned, were confined to the two tributary-seas, Adriatic and Aegean. And extension of the survey by the "Thor" to the open basin itself not only resulted in the addition of 8 more species (double starred in the list, p. 136), but the number of species of Calycophorae taken by the "Thor" in the eastern basin (17) fell only 3 short of the number taken in the western, although about twice as many tows were made in the latter as in the former (Fig. 1). Neither does the distribution of "Thor" captures of agalmids (in this case specific identifications are not possible, p. 62) suggest any notable preponderance in the one basin as contrasted with the other (Fig. 82). And when we contrast the intensive towing campaigns which had been previously carried out in the west by the Prince of Monaco (Leloup, 1933) as well as from the various biological stations, with the paucity of early observations in the east, it seems not unlikely that all the siphonophores now known from west of the Pantellarian Channel may eventually be found to the east as well; — especially when one remembers how sporadic in their occurrence many siphonophores are anywhere. In this connection, one might mention the proverbially sudden appearances and disappearances of swarms of *Velella* or quote Moser's (1917, p. 722) account of the appearance of a vast swarm of *Physalia* at Naples, where it was "so unbekannt, dass, als man dem einen alten, sehr erfahrenen Fischer ein Exemplar in die Station brachte, dieser an einen schlechten Witz glaubte und eine Schweinsblase zu sehen vermeinte, bis er sich am Meer selbst von dem Wunder überzeugte". Remembering that the two most recent captures of so conspicuous a siphonophore as *Porpema prunella* were 30 years apart (Haeckel, 1888b; Bigelow, 1911b), one in the western and the other in the eastern side of the Tropical Pacific, and those of its Atlantic relative, *P. globosa*, almost 50 years apart (Eschscholtz, 1829; Haeckel, 1888b, as *P. medusa*), it is dangerous to postulate that any siphonophore may not be found in any particular locality where conditions are suitable for its existence.

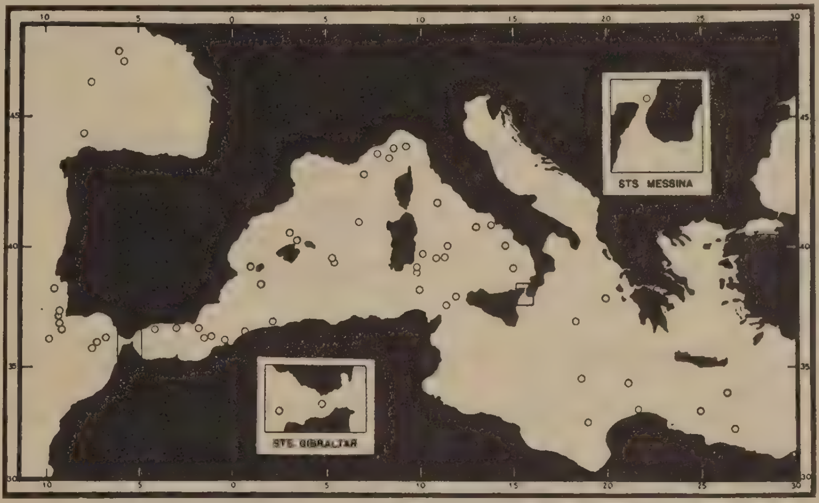

Fig. 82. "Thor" captures of Agalmidae, species not identifiable (p. 62).

In short, it becomes increasingly unlikely that any pronounced qualitative difference exists, between the Siphonophorae of the western and eastern sides of the Mediterranean, but that the relationship here, via the Pantellarian Channel, is essentially the same as exists between the western basin and the neighboring parts of the Atlantic via the Straits of Gibraltar. At the most, it may be assumed that the species (p. 127) which enter the Mediterranean only occasionally, and which fail to establish permanent populations there, would appear still more sporadically in the eastern basin than in the western.

List of siphonophores definitely known from the western basin[1]. Those starred once are also known from the eastern basin; those double starred having been found there for the first time by the "Thor".

**_Muggiaea atlantica_
*_Muggiaea kochii_
*_Sphaeronectes truncata_
_Sphaeronectes irregularis_
**_Amphicaryon acaule_
*_Rosacea cymbiformis_
_Rosacea plicata_
_Rosacea medusa_
_Stephanophyes superba_
_Clausophyes ovata_
*_Abylopsis tetragona_
_Abylopsis eschscholtzii_
_Ceratocymba sagittata_
*_Bassia bassensis_
_Diphyes dispar_
_Diphyes bojani_
*_Chelophyes appendiculata_
*_Eudoxoides spiralis_
*_Lensia conoidea_
**_Lensia fowleri_
**_Lensia multicristata_
*_Lensia subtilis_
*_Lensia campanella_
_Chuniphyes multidentata_
*_Galetta chuni_
*_Galetta australis_
_Galetta meteori_
*_Sulculeolaria quadrivalvis_
**_Sulculeolaria quadridentata_
*_Hippopodius hippopus_
*_Vogtia pentacantha_
**_Vogtia glabra_
**_Vogtia spinosa_
_Apolemia uvaria_
*_Forskalia_
_Agalma okeni_
_Agalma elegans_
_Agalma clausi_
*_Stephanomia bijuga_
*_Stephanomia rubra_
_Anthemodes ordinata_
_Lynchnagalma utricularia_
_Athorybia rosacea_
*_Physophora hydrostatica_
**_Rhizophysa filiformis_
*_Porpita umbella_
*_Velella velella_
_Physalia physalis_

## NUMERICAL ABUNDANCE, ATLANTIC AND MEDITERRANEAN.

The "Thor" collection for the first time affords numerical data from which some rough approximation can be arrived at as to relative abundance in the Atlantic as compared to the two basins of the Mediterranean, whether for individual species or for the siphonophore populations as a whole.

The average catches per hour, for all hauls in which the respective species were taken at all times of year, were as follows:—

Table 53.

| Species | Atlantic | | Mediterranean | | | |
|---|---|---|---|---|---|---|
| | | | Wester basin | | Eastern basin | |
| | No. per hour | No. per 5000 Cu. M. | No. per hour | No. per 5000 Cu. M. | No. per hour | No. per 5000 Cu. M. |
| _Hippopodius hippopus_ | 0.9 | 0.8 | 4 | 3.6 | 7 | 6.3 |
| _Enneagonum hyalinum_ | 1.0 | 0.9 | 6 | 5.4 | 0 | 0 |
| _Abylopsis tetragona_ | 0.4 | 0.3 | 61 | 54.9 | 4 | 3.6 |
| _Bassia bassensis_ | 97. | 87.3 | 4 | 3.6 | 27 | 24.3 |
| _Galetta australis_ | <1. | <0.9 | 3 | 2.7 | 1 | 0.9 |
| _Muggiaea atlantica_ | 7. | 6.3 | 7 | 6.3 | 2 | 1.8 |
| _Chelophyes appendiculata_ | 112. | 100.8 | 166 | 149.4 | 157 | 141.3 |
| _Eudoxoides spiralis_ | 2. | 1.8 | 9 | 8.1 | 15 | 13.5 |
| _Lensia conoidea_ | 12. | 10.8 | 8 | 7.2 | 6 | 5.4 |
| _Lensia fowleri_ | 0.3 | 0.2 | 4 | 3.6 | 6 | 5.4 |
| _Lensia multicristata_ | 2. | 1.8 | 7 | 6.3 | 2 | 1.8 |

From this it appears that among the more common species, only one (_Bassia_) averaged decidedly more numerous in the Atlantic than in the Mediterranean, while the reverse was true of two, _Abylopsis tetragona_ and _Lensia fowleri_. One species, _Abylopsis tetragona_ was much the more abundant in the western basin, but is counter-balanced by another (*Bassia*), which was more abundant in the eastern, while the populations of the rest were of about of the same order of magnitudes in the three regions. Thus, the data do not suggest any general longitudinal contrast in this respect, such as might have been expected from JESPERSEN's (1923) calculations of the amounts of macroplankton taken by the "Thor". And the following calculation of the mean number of siphonophores of all species combined, taken per hour's towing, shows an even closer agreement:[1]

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[1] Doubtful species are omitted.

Atlantic: Total towing hours, 110; mean catch, 275 siphonophores per hour.
Mediterranean, Western basin: Total towing hours, 184.5; mean catch, 277 siphonophores per hour.
Mediterranean, Eastern basin: Total towing hours, 70; mean catch, 231 siphonophores per hour.

In short, the "Thor" records do not lend any support to the view that the western part of the Mediterranean is notably poorer in siphonophores as a whole than the neighboring part of the Atlantic, or that the eastern basin is poorer than the western.

## RELATIVE VERTICAL DISTRIBUTION OF SIPHONOPHORES, AS A WHOLE.

Mediterranean. The mean catch per hour's tow[2] of all species, for all Mediterranean stations combined, was as follows:—

Table 54.

| Depth | No. of tows | No. of nectophores per hour, all species | Depth | No. of tows | No. of nectophores per hour, all species |
|---|---|---|---|---|---|
| 6 + 10 + 16 | 115 | 661 | 533 + 666 | 23 | 227 |
| 26 + 33 + 43 + 63 + 66 | 63 | 520 | 800 + 933 | 8 | 250 |
| 86 + 100 + 133 | 13 | 83 | 1066 + 1100 + 1333 + 1666 + 1733 | 14 | 153 |
| 166 + 200 + 266 | 75 | 275 | 2333 | 1 | 27 |
| 400 | 16 | 381 | 2666 | 2 | 7 |

By this tabulation, the upper 100 meters averaged perhaps twice as productive of siphonophores as any underlying stratum: averages show, however, a considerable population down to 1800 meters, but relatively few from thence downward, though significant numbers evidently existed right down to the bottom water of the Mediterranean.

Atlantic. Similar calculation for the Atlantic stations (Table 55), shows relatively much more definite concentration in the upper 300 meters, with correspondingly much sparser population at depths greater than 400 meters for the group as a whole, as well as for some of the more common species, individually; i. e. *Abylopsis tetragona* (p. 88), *Muggiaea atlantica* (p. 100), *Enneagonum hyalinum* (p. 86), and *Chelophyes appendiculata* (p. 103).

Table 55.

| Depth | No. of tows | No. of nectophores per hour, all species |
|---|---|---|
| 16 | 24 | 910 |
| 30 + 33 + 36 + 43 + 66 | 28 | 573 |
| 166 + 200 + 333 | 20 | 198 |
| 400 | 8 | 56 |
| 533 + 666 | 7 | 146 |
| 800 | 2 | 28 |
| 1066 + 1333 | 5 | 34 |
| 2000 | 1 | 18 |
| 2866 + 2900 | 2 | 15 |

As this decrease in the siphonophore-population with depth, in the parts of the Atlantic sampled by the "Thor", is of the same general order as Leloup and Hentschel's (1935, p. 24, Fig. 17) finding that calycophores along the route of the "Meteor" averaged only about half as abundant at 50—100 meters, about $^{1}/_{4}$ as abundant at 100—200 meters, $^{1}/_{9}$ as abundant at 200—400 meters, and only about $^{1}/_{14}$ as abundant at 600—800 meters as they were close to the surface, it may be taken as characteristic for the Mid-Atlantic as a whole.

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[1] Towing hours in the tabulation include the vertical as well as the horizontal parts of the tows, calculated on the assumption that 1 hour equals 3700 meters as explained on page 68. All tows with the Young Fish Trawl are included, whether siphonophores were taken or not.

[2] The vertical as well as the horizontal portions of the tows are included, calculated on the assumption that 1 hour's tow equals 3700 meters as described on page 68.

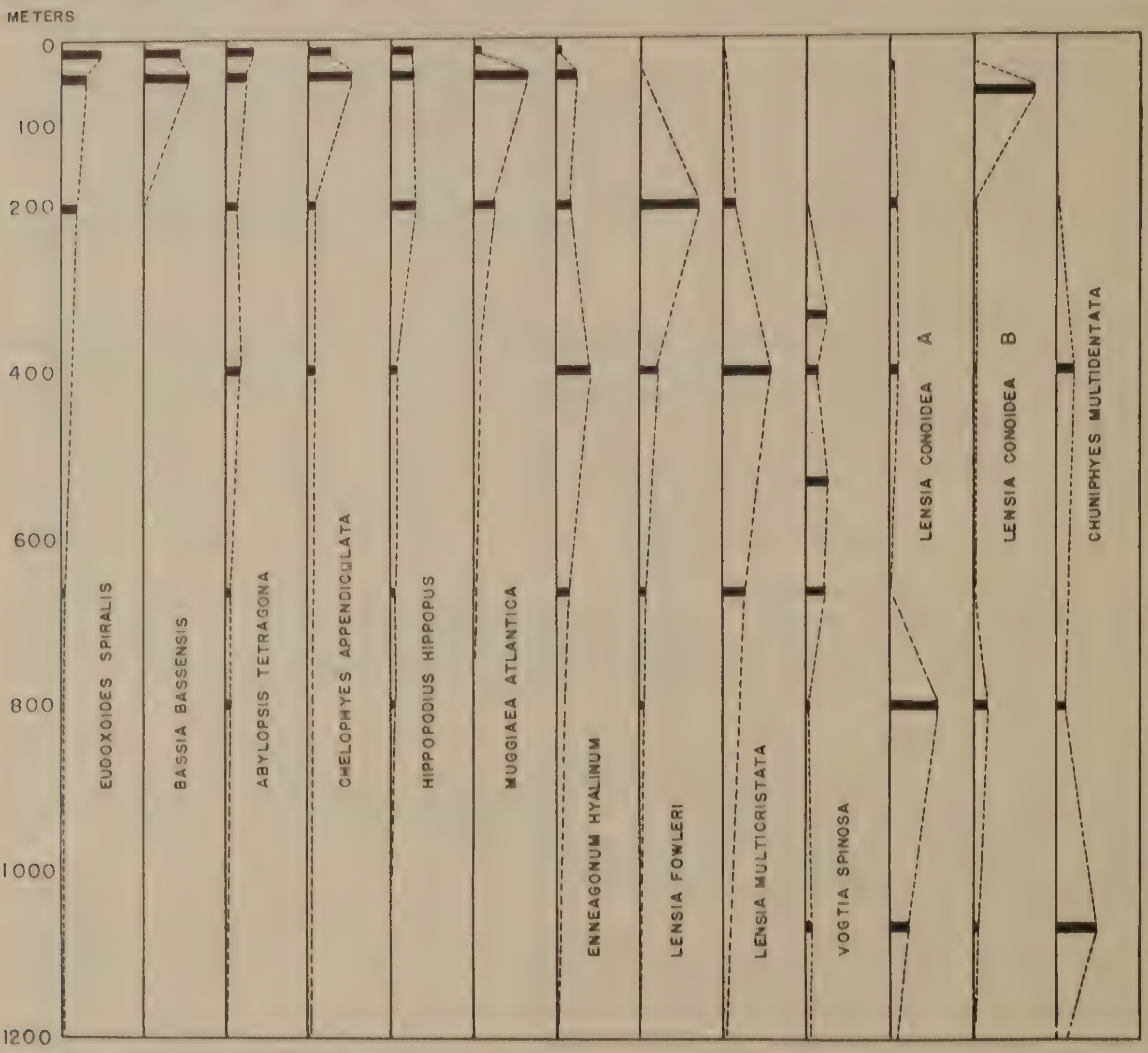

Fig. 83. Relative vertical distribution of the more common species, expressed as tenths of the sum of the mean catches per hour at all levels combined. For *Lensia conoidea*, column A represents distribution, if one very rich catch at 66 meters is omitted; column B, the distribution if this catch be included.

Lacking definite knowledge of the factors that control the vertical distribution of any siphonophore other than the Chondrophorae and *Physalia*, this very striking difference in the extent to which they populate the deeper strata in the Mediterranean, as contrasted with the Atlantic remains a riddle.

Considering how wide a range of temperature most of the common siphonophores are known to inhabit (p. 131), it seems unlikely that the somewhat lower temperatures in the deeper strata of the Atlantic at mid-latitudes, as contrasted with the Mediterranean, would account for greater scarcity of the group at those depths in the former than in the latter; though for individual species it might have that effect, or vice versa. Neither do regional differences in the vertical stability of the water offer any apparent explanation. There is little difference in this respect between the Mediterranean and the Atlantic in summer, while in winter it is in the Atlantic that the upper 200 meters are the less stable (p. 95, Fig. 67), i. e. the more open to the vertical dispersal of any planktonic animals, whereas, in the case of the siphonophores as a whole, the regional relationship in vertical distribution seems to be the reverse. Figure 83 presents graphically, the relative vertical distribution of the more common species.

## RELATIVE ABUNDANCE OF DIFFERENT SPECIES OF SIPHONOPHORES.

The mean numbers of the commoner species per hour's towing, and per 5000 cubic meters of water are tabulated on p. 136. The richest catches per hour and per 5000 cubic meters, for such species as were ever numerous enough to yield catches as large as 100 per hour, were:—

Table 56.

| | Atlantic | | Mediterranean | |
|---|---|---|---|---|
| | No. per hour | No. per 5000 Cu. M. | No. per hour | No. per 5000 Cu. M. |
| *Rosacea cymbiformis* (Nectophores) | 152 | 136.8 | 120 | 108 |
| *Hippopodius hippopus* (Nectophores) | 34 | 30.6 | 300 | 270 |
| *Enneagonum hyalinum* (Colonies) | 22 | 19.8 | 376 | 338.4 |
| — — (Eudoxids) | 31 | 27.9 | 581 | 522.9 |
| *Abylopsis tetragona* (Colonies) | 32 | 28.8 | 5,168 | 4,651.2 |
| — — (Eudoxids) | 74 | 66.6 | 23,664 | 21,297.6 |
| *Bassia bassensis* (Colonies) | 30,492 | 27,442.8 | 3,232 | 2,908.8 |
| — — (Eudoxids) | 16,828 | 15,141.2 | 3,408 | 3,067.2 |
| *Galetta australis* (Nectophores) | 2 | 1.8 | 192 | 172.8 |
| *Muggiaea atlantica* (Nectophores) | 1,000 | 900 | 584 | 525.6[1] |
| *Chelophyes appendiculata* (Nectophores) | 11,170 | 10,053 | 7,116 | 6,404.4 |
| *Eudoxoides spiralis* (Nectophores) | 96 | 86.4 | 433 | 389.7 |
| *Lensia conoidea* (Nectophores) | 390 | 351 | 1,665 | 1,498.5 |
| *Lensia fowleri* (Nectophores) | 20 | 18 | 278 | 250.2 |
| *Lensia multicristata* (Nectophores) | 61 | 54.9 | 458 | 412.2 |

[1] A tow in the Straits of Gibraltar yielded 2804 nectophores per hour or 2526 per 5000 cubic meters of water.

Comparison of the two tables shows that in the Mediterranean, *Chelophyes appendiculata* was much the most abundant species, whether judged by the mean abundance of its colonies or by their maximum abundance. The only species that approached it there, was *Abylopsis tetragona*. But *Bassia bassensis*, *Muggiaea atlantica*, and *Lensia conoidea* all appear in relatively more abundant aggregation, at their maximum, than would have been suggested by their low averages as compared to *C. appendiculata* and *A. tetragona*, illustrating the probability that any species of siphonophores may occasionally swarm even though the population of it averages small. No species other than those listed on p. 136, averaged as numerous as 1 per 5000 cubic meters, in either basin of the Mediterranean.

The relationship of the several species in the Atlantic was different, for while *C. appendiculata* averaged most abundant there, also, among the catches of colonies, *Bassia* closely approached it in average, and considerably surpassed it in maximum abundance, while *Abylopsis tetragona* (second in average rank in the Mediterranean) averaged very scarce in the Atlantic, nor were any swarms of it encountered there.

## MAXIMUM ABUNDANCE OF SIPHONOPHORES AS A WHOLE.

The richest hauls of all siphonophores combined, were at the rate of 35828 colonies per hour, or 32245 per 5000 cubic meters of water in the Bay of Cadiz (St. 233, 25 meters of wire out), of 7218 colonies per hour, or 6496 per 5000 cubic meters of water in the western basin of the Mediterranean (St. 123, 65 meters of wire out), and of 7424 colonies per hour, or 6681 per 5000 cubic meters of water in the eastern basin (St. 183, 65 meters of wire out).

## BIBLIOGRAPHY.

AGASSIZ, L., 1862. Contributions to the Natural History of the United States of America. Vol. 4, 8 + 372 + (12) pp., Pls. 20—35. Boston.

BEDOT, M. 1882. Sur la faune des Siphonophores du Golfe de Naples. Mitt. Zool. St. Neap., Vol. 3, pp. 121—123.

1884. Recherches sur l'organe central et le système vasculaire des vélelles. Rec. Zool. Suisse, Vol. 1, pp. 491—517, Pls. 25—26.

1894. Note sur une larve de Vélelle. Rev. Zool. Suisse, Vol. 2, pp. 463—466, Pl. 21.

1896. Les Siphonophores de la Baie d'Amboine, étude suivie d'une revision de la famille des Agalmidae. Rev. Zool. Suisse, Vol. 3, pp. 367—414, Pl. 12.

1904. Siphonophores provenant des campagnes du Yacht Princesse Alice (1892—1902). Résult. Camp. Scient. Monaco, Vol. 27, 27 pp., 4 pls.

BIGELOW, H. B. 1911 a. Biscayan Plankton collected during a cruise of H. M. S. "Research", 1900. XIII. The Siphonophora. Trans. Linn. Soc., London, ser. 2, Zool., Vol. 10, Pt. 10, pp. 337—358, Pl. 28.

1911 b. Reports on the scientific results of the expedition to the Eastern Tropical Pacific, 1904—1905. XXIII. The Siphonophorae. Mem. Mus. Comp. Zool., Vol. 38, pp. 171—402, 32 pls.

1913. Medusae and Siphonophorae collected by the U. S. Fisheries steamer "Albatross" in the Northwestern Pacific, 1906. Proc. U. S. Nat. Mus., Vol. 44, pp. 1—119, Pls. 1—6.

1918. Some Medusae and Siphonophorae from the Western Atlantic. Bull. Mus. Comp. Zool., Vol. 62, No. 8, pp. 365—442, 8 pls.

1919. Hydromedusae, Siphonophores, and Ctenophores of the "Albatross" Philippine Expedition. Bull. U. S. Nat. Mus., No. 100, Vol. 1, Pt. 5, pp. 279—362, Pls. 39—43.

1931. Siphonophorae from the Arcturus Oceanographic Expedition. Zoologica, Sci. Contr. N. Y. Zool. Soc., Vol. 8, No. 11, pp. 525—592, Textfigs. 185—220.

BIGELOW, H. B., and LESLIE, MAURINE. 1930. Reconnaissance of the Waters and Plankton of Monterey Bay, July 1928. Bull. Mus. Comp. Zool., Vol. 70, No. 5, pp. 429—581, 43 textfigs.

BLAINVILLE, H. M. D. DE, 1834. Manuel d'Actinologie, ou de Zoophytologie. 8 + 644 pp., Atlas, 100 pls. Paris.

BLES, E. J. 1892. Notes on the Plankton observed at Plymouth during June, July, August, and September, 1892. Journ. Mar. Biol. Assoc., n. s., Vol. 2, p. 340—343.

BOONE, L. 1933. Scientific Results of the Cruises of the Yachts "Eagle" and "Ara", 1921—1928, William K. Vanderbilt, commanding. Coelenterata, Echinodermata and Mollusca. Bull. Vanderbilt Mar. Mus., Huntington, Vol. 4, 217 pp., 133 pls.

BOURNE, G. C. 1890. Report of a Trawling Cruise in H. M. S. "Research" off the South-west Coast of Ireland. Jour. Mar. Biol. Assoc., n. s., Vol. 1, p. 306—323.

BRANDT, J. F. 1835. Prodromus Descriptionis . . . circumnavigatione Observatorum. Fasic. I., 76 pp. Petropoli.

BROWNE, E. T. 1926. Siphonophorae from the Indian Ocean. Collected by Professor Stanley Gardiner in H. M. S. SEALARK. Trans. Linn. Soc., 2 ser., Zool., Vol. 19, Pt. 1, pp. 55—86.

BUSCH, W. 1851. Beobachtungen über Anatomie und Entwickelung einiger wirbellosen Seethiere. 143 pp., 17 pls. Berlin.

CANDEIAS, A. 1929. Note sur quelques Siphonophores *Calycophorae* de Madère. Bull. Soc. portug. Sci. Nat., Vol. 10, pp. 269—284.

1932. Contribuição para o conhecimento dos Coelenterados plânctónicos des Costas portuguesas. Mem. Est. Mus. Zool. Univ. Coimbra, Ser. 1, No. 57, pp. 1—11, 2 pls.

CARUS, J. V. 1884. Prodromus Faunae Mediterranae, etc. Vol. 1, 524 pp. Stuttgart.

CHAMISSO, A. DE, and EYSENHARDT, C. G. 1821. De animalibus quibusdam e classe Vermium . . . Nova Acta Acad. Caes. Leop., Vol. 10, pp. 345—374, Pls. 24—33.

CHUN, C. 1885. Über die cyklische Entwickelung der Siphonophoren. Mathem. u. Naturwiss. Mitt. Preuss. Akad. Wiss. Berlin, pp. 263—281 (511—529), Pl. 2.

1886. Über Bau und Entwickelung der Siphonophoren. Mathem. u. Naturwiss. Mitt. Preuss. Akad. Wiss. Berlin, pp. 449—456 (681—688)

CHUN, C. 1887. Die pelagische Thierwelt in grösseren Meerestiefen und ihre Beziehungen zu den Oberflächenfauna. Bibliotheca Zoologica, Vol. 1, Pt. 1, pp. 1—66, 5 pls.

— 1888. Bericht über eine nach den Canarischen Inseln im Winter 1887—88 ausgeführte Reise. Mathem. u. Naturwiss. Mitt. Preuss. Akad. Wiss., Berlin, pp. 749—781 (1141—1173).

— 1892. Die Canarischen Siphonophoren... 2. Die Monophyiden. Abh. Senckenb. Nat. Ges., Vol. 18, pp. 57—144, Pls. 8—12.

— 1897. Die Siphonophoren der Plankton-Expedition. Ergeb. der Plankton Exp., Vol. 2, K. b., 126 pp. 8 pls.

— 1913. Über den Wechsel der Glocken bei Siphonophoren. Berichte über Verhandl. König. sächsischen Gesell. Wissen., Leipzig. Mathem-Phys. Klasse, Vol. 65, pp. 27—41, 8 figs.

CIALONA, M. 1901. Osservazioni pratiche sull'epoca della comparsa e della variabilità quantitativa delle specie animali più comuni nel Plankton del porto di Messina. Ricerche fatte nel Laboratorio di Anatomie normale della R. Università di Rome, Vol. 8, pp. 149—155, 2 textfigs.

CLAUS, C. 1860. Über Physophora hydrostatica nebst Bemerkungen über andere Siphonophoren. Zeit. f. wiss. Zool., Vol. 10, pp. 295—332, Pls. 25—27.

— 1863. Neue Beobachtungen über die Structur und Entwickelung der Siphonophoren. Zeit. f. wiss. Zool., Vol. 12, pp. 536—563, Pls. 46—48.

— 1878. Über Halistemma tergestinum n. sp. nebst Bemerkungen über den feinern Bau der Physophoriden. Arb. Zool. Inst. Wien, Vol. 1, pp. 1—56, Pls. 1—5.

— 1879. Agalmopsis Utricularia, eine neue Siphonophore des Mittelmeeres. Arb. Zool. Inst. Wien, Vol. 2, pp. 1—3, (199)—(201), 1 pl.

COSTA, A. 1862. Osservazioni sulla Diphya quadrivalvis e su' Crostacei che si sviluppano entro i bottoni delle appendici urticanti. Annuaro del Museo Zoologico della R. Università di Napoli, Vol. 1, Article 10, pp. 90—94,

COSTA, O. G. 1836. Fauna del regno di Napoli ossia enumerazione di tutti gli animali che abitano le diverse regioni di questo regno e le acque che le bagnano. Medusari. pp. 1—20, 1—18, 1—14, 1—10, 1—12, 8 pls. Naples.

CUNNINGHAM, J. T. 1892. On a Species of Siphonophore observed at Plymouth. Jour. Mar. Biol. Assoc., new ser., Vol. 2, pp. 212—215, textfigs. 1—2.

CUVIER, G. 1817. Le règne animal... Vol. 4, 255 pp., 15 pls.

DE BUEN, R. 1934. Caractères Océanographiques du Secteur Sud (Plateau Continental Atlantique). Rapp. atlantique 1932. Rapp. Proc. verb. Cons. perm. int. l'expl. de la mer, Vol. 87, pp. 33—44, textfigs. 14—31.

DE GREGORIO, M. A. 1892. Intorno a taluni Celenterati mediterranei viventi. Natural. Sicil., Vol. 12, No. 3, pp. 74—75.

DELLE CHIAJE, S. 1822—1829. Memoria sulla storia e notomia degli animali senza vertebre del Regno di Napoli. 4 vols. and Atlas, 109 pls. Naples.

— 1841—1844. Descrizione e Notomia degli animali invertibrati della Sicilia citeriore... 8 vols. and Atlas, 181 pls. Naples.

DÖNITZ, W. 1871. Über eigenthümliche Organe an den Magenstücken der Siphonophoren. Arch. Anat. Physiol. und Wissen. Med., pp. 83—89, Pl. 3.

ESCHSCHOLTZ, FR. 1829. System der Acalephen. 188 pp., 16 pls. Berlin.

FEWKES, J. W. 1879. The tubes in the larger nectocalyx of *Abyla pentagona*. Proc. Boston Soc. Nat. Hist., Vol. 20, pp. 318—324. 1 pl.

— 1880. Contributions to a Knowledge of the Tubular Telly-fishes. Bull. Mus. Comp. Zool., Vol. 6, pp. 127—146, 3 pls.

— 1882. Explorations of the Surface Fauna of the Gulf Stream, under the Auspices of the U. S. Coast Survey, by Alexander Agassiz. 1. Notes on Acalephs from the Tortugas, with a Description of New Genera and Species. Bull. M.C.Z., Vol. 9, pp. 251—284, 7 pls.

FORBES, E. 1844. Report on the Mollusca and Radiata of the Aegean Sea., and on their distribution, considered as bearing on Geology. Rep. Brit. Assoc. Adv. of Sci. 13 Meeting, 1843, pp. 130—193. London.

FORSKÅL, P. 1775. Descriptiones animalium...quae in Itinere Orientali observavit. Ed. C. NIEBUHR. 20, 34, 164 pp., 1 Map. Hauniae.

— 1776. Icones rerum naturalium quas in Itinere Orientali depingi curavit P. FORSKÅL. Ed. C. NIEBUHR. 15 pp., 43 pls. Hauniae.

GARSTANG, W. 1894. Faunistic notes on Plymouth during 1893—1894, p. 211—229 (Cited from MOSER, 1925).

GEGENBAUR, C. 1853. Über einige niedere Seethiere. Zeit. f. wiss. zool.. Vol. 5, pp. 103—117.

— 1853 a. Beiträge zur näheren Kenntniss der Schwimmpolypen (Siphonophoren). Zeit. Wiss. Zool., Vol. 5, pp. 285—344, Pl. 16—18.

— 1854. Über Diphyes turgida n.sp. nebst Bemerkungen über Schwimmpolypen. Zeit. Wiss. Zool., Vol. 5, pp. 442—454, Pl. 23.

— 1860. Neue Beiträge zur näheren Kenntniss der Siphonophoren. Nov. Acta Caes. Leop., Vol. 27, pp. 331—424, 7 pls.

GOUGH, L. H. 1905. On the Distribution and the Migrations of *Muggiaea atlantica*, Cunningham, in the English Channel, the Irish Sea, and off the South and West Coasts of Ireland, 1904. Publ. de Circ. No. 29, Cons. perm. int. l'exp. de la mer, pp. 3—13, 2 textfigs., 3 charts.

GRAEFFE, E. 1858. Beobachtungen über Radiaten und Würmer in Nizza. Denkschrift. schw. naturforsch. Gesell., vol. 2, 59, pp., 1 pl. Zürich.

— 1884. Übersicht der Seethierfauna des Golfes von Trieste III. Coelenteraten. Arb. Zool. Inst. Wien, Vol. 5, pp. 1—30, (333)—(362).

GRANGER, A. 1879. Note sur des Velelles (Velella limbosa, L.) observées à Cette. Act. Soc. Linn. de Bordeaux, ser. 4, Vol. 3, Proc. Verb., pp. XLVI—XLVII.

HAECKEL, E. 1888 a. System der Siphonophoren... Jena Zeitschr. Naturwiss., Vol. 22, pp. 1—46.

— 1888 b. Report on the Siphonophorae. Rept. Sci. results H. M. S. Challenger, Vol. 28, 380 pp., 50 pls.

HARDY, A. C., and GUNTHER, E. R. 1935. The plankton of the South Georgia whaling grounds and adjacent waters, 1926—1927. Discovery Reports, Vol. 11, pp. 1—456, 192 textfigs.

HOLLARD, M. H. 1845. Recherches sur l'organisation des vélelles. Ann. des Sci. nat., Zool., 3 ser., Vol. 3, p. 248—254, Pl. 4, Figs. 28—34.

Huxley, T. H. 1859. The Oceanic Hydrozoa. Ray Soc., 141 pp. 12 pls. London.

Jespersen, P. 1915. Sternoptychidae (Argyropelecus and Sternoptyx). Rep. Dan. Ocean. Exp. 1908—1910 to the Mediterranean and Adjacent Seas, No. 3, Vol. II, (Biology), A. 2, pp. 1—33, 6 textfigs.

1923. On the quantity of Macroplankton in the Mediterranean and the Atlantic. Rep. Dan. Ocean. Exp. 1908—1910 to the Mediterranean and Adjacent Seas, No. 7, Vol. 3, (Misc. papers), Pt. 3, pp. 3—17, 8 textfigs.

Keferstein, W., and Ehlers, E. 1860. Auszug aus den Beobachtungen über die Siphonophoren von Neapel und Messina angestellt in Winter 1859—60. Nachrichten von der Georg August Universität und der Königl. Gesellschaft der Wissenschaft zu Gottingen, No. 23, pp. 254—262.

— 1861. Zoologische Beiträge gesammelt im Winter 1859—60 in Neapel und Messina. Pt. 1. Beobachtungen über die Siphonophoren von Neapel und Messina. 34 pp., Pls. 1—5. Leipzig.

Kölliker, A. 1853a. Die Schwimmpolypen oder Siphonophoren von Messina. 96 pp., 12 pls. Leipzig.

— 1853b. Bericht über einige in Herbste 1852 in Messina angestellte vergleichendanatomische Untersuchungen über Siphonophoren. Zeit. f. wiss. Zool., Vol. 4, pp. 306—315.

Korotneff, A. 1884. Zur Histologie der Siphonophoren. Mitth. Zool. Neapel, Vol. 5, pp. 229—288, pls. 14—19.

Kramp, P. 1924. Medusae. Rept. Dan. Ocean. Exp. 1908—1910 to the Mediterranean and Adjacent Seas, No. 8, Vol. 2, (Biology), H. 1, pp. 1—67, 40 textfigs., 12 charts.

Leloup, E. 1932. L'eudoxie d'un siphonophore calycophoride rare, le *Nectopyramis thetis* Bigelow. Bull. Mus. Hist. nat. Belg., Vol. 8, No. 3, pp. 1—8, 5 textfigs.

— 1932a. Contribution à la répartition des siphonophores calycophorides. Bull. Mus. Hist. nat. Belg., Vol. 8, No. 11, pp. 1—30.

— 1933. Siphonophores calycophorides provenant des campagnes du Prince Albert 1er de Monaco. Rés. camp. sci. Monaco, Vol. 87, pp. 1—64, Pl. 1.

— 1934. Siphonophores calycophorides de l'ocean atlantique tropical et austral. Bull. Mus. Hist. nat. Belg., Vol. 10, No. 6. pp. 1—87.

— 1935. Les siphonophores de la rade de Villefranche-sur-mer (Alpes Maritimes, France). Bull. Mus. Hist. nat. Belg., Vol. II, No. 31, pp. 1—12.

— 1935a. Hydropolypes calyptoblastiques et siphonophores récoltés au cours de la croisière (1934—1935) du navire-école belge "Mercator". Bull. Mus. Hist. nat. Belg., Vol. 11, No. 34, pp. 1—6.

— 1936. Siphonophores récoltés dans la région de Monaco. Bull. Inst. Océan. Monaco. No. 703, pp. 1—15.

Leloup, E., and Hentschel, E. 1935. Die Verbreitung der calycophoren Siphonophoren im Südatlantischen Ozean. Wiss. Ergeb. Deutschen Atlantischen Expedition . . ., "Meteor", 1925—1927, Vol. 12, Pt. 2, pp. 1—31.

Lens, A. D., and Van Riemsdijk, Th. 1908. The Siphonophora of the Siboga Expedition. Siboga Exped. Monogr., Vol. 38, 130 pp., 24 pls.

Leuckart, R. 1853. Zoologische Untersuchungen. I. Siphonophoren. 95 pp., 3 pls. Giessen.

— 1854. Zur nähern Kenntniss der Siphonophoren von Nizza. Arch. f. Naturgesch., Jahrg. 20, Vol. 1, pp. 249—377, Pls. 11—13.

Linné, C. von. 1758. Systema naturae. . . Ed. 10, Vol. 1, 823 pp.

Lo Bianco, S. 1888. Notizie biologiche riguardanti specialmente il periodo di maturità sessuale degli animali del golfo di Napoli. Mitt. Zool. Stat. Neapel, Vol. 8, pp. 385—440.

— 1899. Notizie biologiche riguardanti specialement il periodo di maturità sessuale degli animali del golfo di Napoli. Mitt. Zool. Stat. Neapel, Vol. 13, pp. 448—573.

— 1903. Le pesche abissali eseguite da F. A. Krupp col Yacht Puritan nelle adiacenze di Capri ed in altre località del Mediterraneo. Mitt. Zool. Stat. Neapel, Vol. 16, pp. 109—278.

Lochman, L. 1914. Zur Entwicklungsgeschichte der Siphonophoren. Zeit. Wiss. Zool., Vol. 108, pp. 258—289, Pl. 7, 5 textfigs.

Metschnikoff, E. 1870. Studies on Siphonophores and Medusae [Russian]. Bull. Friends nat. hist. Moscow, Vol. 8, pp. 225—370, 6 pls.

— 1874. Studien über die Entwickelung der Medusen und Siphonophoren. Zeit. Wiss. Zool., Vol. 24, pp. 15—83, Pls. 2—12, 8 textfigs.

Moser, F. 1912. Über eine festsitzende Ctenophore und eine rückgebildete Siphonophore. Sitz. Gesellsch. naturforsch. freunde, Berlin, Jahrg. 1912, pp. 522—544.

— 1913. Der Glockenwechsel der Siphonophoren, Pneumatophore, Urknospen, geographische Verbreitung und andere Fragen. Zool. Anz., Vol. 43, pp. 223—234.

— 1915. Die geographische Verbreitung und das Entwicklungszentrum der Röhrenquallen. Sitzungsber. d. Gesellsch. Naturforsh. Freunde z. Berlin, Jahrg. 1915, No. 6, pp. 203—219.

— 1917. Die Siphonophoren der Adria und ihre Beziehungen zu denen des Weltmeeres. Sitzungsber. Kaiserl. Akad. d. Wissensch. in Wien, Mathem.-naturw. Klasse, Section 1, Vol. 126, Part. 9, pp. 703—763, Pls. 1—4, 1 map.

— 1923. Die larvalen Verhältnisse der Siphonophoren in neuer Beleuchtung. Zoologica, Vol. 28, Pt. 1, pp. 1—52, 35 textfigs., Pls. 1—5.

— 1925. Die Siphonophoren der Deutschen Südpolar-Expedition 1901—1903. Deutsche Südpolar-exped., Vol. 17, Zool., Vol. 9, pp. 1—541, 33 pls.

Möller, O. F. 1776. Beschreibung zwoer Medusen. Beschaftigungen Berlin Gesellschaft Naturforschender Freunde, Vol. 2, pp. 290—297, Pl. 9.

Müller, P. E. 1871. Iagttagelser over Nogle Siphonophorer. Naturhist. Tidsskr. 3. Ræk., Vol. 7, pp. 261—332, 541—547, Pls. 11—13.

Münter, H. 1912. Morphologie und Histologie von Hippopodius hippopus Forskål nebst entwicklungsgeschichtlicher Bemerkungen. Diss. Münster Erfurt (Druck v. Ohlenroth).

Murray, J., and Hjort, J. 1912. The Depths of the Ocean. 821 pp., 575 textfigs. London.

Neppi, V. 1921. I sifonofori del golfo di Napoli. Publ. Staz. Zool. Napoli, Vol. 3, pp. 223—228.

Nielsen, J. N. 1912. Hydrography of the Mediterranean and adjacent waters. Rep. Dan. Ocean. Exp. 1908—1910 to the Mediterranean and Adjacent Seas, Vol. 1, pp. 77—191, 19 textfigs., 11 pls.

Otto, A. W. 1823. Beschreibung einiger neuer Mollusken und Zoophyten. Nova Acta Acad. Caes. Leop., Vol. 11, pp. 273—314, Pls. 38—42.

Pagenstecher, H. A. 1869. Eine neue Entwickelungsweise bei Siphonophoren. Zeit. f. wiss. Zool., Vol. 19, Pt. 2, pp. 244—252, Pl. 21.

Pavesi, P. 1869. . . Coelenterates in Enciclopedia medica italiana 1869—1899. Edited by Francesco Vallardi (cited from Spagnolini 1876).

Philippi, R. A. 1843. Über der Bau der Physophoren und eine neue Art derselben, *Physophora tetrasticha*. Arch. f. Anat. u. Phys., pp. 58—67, Pl. 5.

Quoy, J. R. C., et Gaimard, J. P. 1827. Observations zoologiques faites à bord de l'*Astrolabe*, en mai 1826, dans le détroit de Gibraltar. Ann. Sci. Nat., Vol. 10, pp. 5—21, 172—193, Pls. 1, 2, 4—6, 9.

1934. Voyage... *Astrolabe*. Zoologie. Zoophytes. Vol. 4., 390 pp., 26 pls. in atlas. Paris.

Richard, J. 1934. Liste générale des stations des Campagnes scientifiques du Prince Albert de Monaco avec notes et observations. Res. Camp sci. Monaco, Vol. 89, 471 pp., 8 pls.

Richter, W. 1907. Die Entwicklung der Gonophoren einiger Siphonophoren. Zeit. f. wiss. Zool., Vol. 86, pp. 557—618, Pls. 27—29.

Risso, A. 1826. Histoire naturelle des principales productions de l'Europe méridionale et particulièrement des celles de environs de Nice et des Alpes Maritimes. Vol. 5, 403 pp., 10 pls.

Romer, F. 1902. Die Siphonophoren; in Romer und Schaudinn, Fauna Artica, Vol. 2, pp. 169—184.

Rose, M. 1933. Sur un Infusoire Foettingéridé parasite des Siphonophores. Compt. rend. Séances Acad. Sci. Paris, Vol. 197, pp. 868—869, 1 textfig.

Runnström, S. 1932. Eine Übersicht über das Zooplankton des Herdla- und Hjeltefjordes. Bergens Mus. Aarb. 1931, No. 7, pp. 1—67, 4 textfigs.

Russell, F. S. 1934. On the occurrence of the siphonophores, *Muggiaea atlantica* Cunningham and *Muggiaea kochii* (Will) in the English Channel. J. Mar. Biol. Assoc. Vol. 19 (2), pp. 555—558.

Russell, F. S. and Colman, J. S. 1931. The Zooplankton. I. Gear, methods and station lists. Brit. Mus. (N. H.) Great Barrier Reef Expedition, 1928—1929, Sci. Repts., Vol. 2, Pt. 2, pp. 5—35, 1 pl.

— 1935. The Zooplankton. IV. The occurrence and seasonal distribution of the Tunicata, Mollusca, and Coelenterata (Siphonophora). Ibid. Vol. 2, Pt. 7, pp. 203—276, 31 textfigs.

Ruud, J. T. 1936. Euphausiacea. Rep. Dan. Ocean. Exp. 1908—1910, Nr. 11, Vol. 2, (Biology), D. 6, 86 pp. 22 textfigs.

Sandström, J. W. 1919. The Hydrodynamics of Canadian Atlantic Waters. Can. Fish. Exped., 1914—1915, pp. 221—343, 59 textfigs., 15 pls.

Sars M. 1846. Fauna littoralis Norvegiae. Vol. 1, Pt. 1, 94 pp., 10 pls. Christiania.

— 1857 (1859). Bidrag til Kundskaben om Middelhavets Littoral-Fauna, Reisebemærkninger fra Italien. Nyt Mag. Naturvidenskaberne. Vol. 10, Part. 1, pp. 1—99, 2 pls.

— 1877. New and Little Known Coelenterates. Fauna Littoralis Norvegiae, Vol. 3, pp. 1—48, Pl. 5. Bergen.

Schmidtlein, R. 1880. Vergleichende Übersicht über das Erscheinen grösserer pelagischer Thiere und Bemerkungen über Fortpflanzungsverhältnisse einiger Seethiere im Aquarium. Vergleichende Übersicht über das Erscheinen grösserer pelagischer Thiere während des Jahres 1879. Mittheil. Zool. St. Naples., Vol. 2, pp. 162—165.

Schmidt, J. 1912. Introduction. Rep. Dan. Ocean, Exp. 1908—1910 to the Mediterranean and Adjacent Seas, Vol. I, Pt. 1, pp. 3—75, 12 textfigs.

Schneider, K. C. 1898. Mittheilungen über Siphonophoren. III. Systematische und andere Bemerkungen. Zool. Anz., Vol. 21, pp. 51—57, 73—95, 114—133, 153—173, 185—200.

Spagnolini, A. 1868. Catalogo degli Acalefi del Golfo di Napoli. Atti Soc. ital. di scienze naturali, Vol. 11, pp. 2—5.

— 1870. Catalogo degli Acalefi del Golfo di Napoli. I. Sifonofori. 46 pp. Milano.

— 1876. Catalogo sistematico degli Acalfi del Mediterraneo. Sifonofori e Meduse Craspedote. Atti della Soc. Ital. di Scienzi naturali, Vol. 19, pp. 291—333, 6 pls.

Stechow, E. 1921. Neue Genera und Species von Hydrozen und anderen Evertebraten. Arch. f. Naturgesch., Jahrg. 87, Sect. A, Pt. 3, pp. 248—265.

Stephensen, K. 1918. Hyperiidea-Amphipoda (Lanceolidae, Scinidae, Vibiliidae, Thaumatopsidae). Rep. Dan. Ocean. Exp. 1908—1910, to the Mediterranean and Adjacent Seas, No. 5, Vol. 2, (Biology), D. 2, pp. 3—70, 32 textfigs., 7 charts.

— 1923. Decapoda-Macrura (excl. Sergestidae). Ibid., No. 7, Vol. 2, (Biology), D. 3, pp. 3—85, 27 textfigs., 8 charts.

— 1924. Hyperiidea-Amphipoda (part 2). Ibid., No. 8, Vol. 2, (Biology), D. 4, pp. 73—149, 20 textfigs., 15 charts.

— 1926. Hyperiidea-Amphipoda (part 3). Ibid., No. 9, Vol. 2, (Biology), D. 5, pp. 153—252, 35 textfigs., 8 charts.

Stiasny, G. 1911. Beobachtungen über die marine Fauna des Triester Golfes während des Jahres 1910. Zool. Anz., Vol. 37, pp. 517—522.

— 1912. Beobachtungen über die marine Faune des Triester Golfes während des Jahres 1911. Zool. Anz., Vol. 39, pp. 604—608.

Sverdrup, A. 1922. Planktonundersökelser fra Kristianiafjorden. Hydromeduser. Skrifter Videnskap. I. Mathem.-Naturviden, Klasse vol. 1, 1921, pp. 1—50, 4 pls., 5 charts, 4 textfigs.

Totton, A. K. 1925. Note on some little-known Siphonophora from the Atlantic Ocean. Ann. Mag. Nat. Hist., ser. 9, Vol. 16, pp. 446—449.

— 1932. Siphonophora. Brit. Mus. (N.H.) Great Barrier Reef Expedition, 1928—1929, Sci. Repts., Vol. 4, Pt. 10, pp. 317—374, 36 textfigs.

VERANY, G. B. 1846. Catalogo degli animali invertebrati marini del Golfo di Genova e Nizza. Guida di Genova, pp. 3—30, 2 pls. Genova.

VOGT, C. 1851. Zoologische Briefe, etc. 2 vols. Frankfurt.

— 1852. Über die Siphonophoren. Zeit. Wiss. Zool., Vol. 3, pp. 522—525, Pl. 14.

— 1854. Recherches sur les animaux inférieurs de la Méditerranée. I. Sur les Siphonophores de la mer de Nice. Mém. Inst. National Genevois. Vol. 1, pp. 1—164, 21 pls.

WEISMANN, A. 1883. Die Entstehung der Sexualzellen bei den Hydromedusen... 295 pp. and Atlas of 24 pls. Jena.

WILL, J. G. F. 1844. Horae Tergestinae... der im Herbste 1843 bei Trieste beobachteten Akalephen. 86 pp., 2 pls. Leipzig,

WINSOR, C. P., and WALFORD, L. A. 1936. Sampling Variations in the Use of Plankton Nets. Jour. de Cons., Vol. 11, No. 2, pp. 190—204.

WOLTERECK, R. 1905. Bemerkungen zur Entwickelung der Narcomedusen und Siphonophoren. Verhandl. der Deutsch Zoologischen Gesellschaft. pp. 106—122, 21 textfigs.

WÜST, G. 1932. Das Ozeanographische Beobachtungsmaterial (Serienmessungen). Wiss. Ergeb. Deutschen Atlantischen Expedition... "Meteor", 1925—1926, Vol. 4, Pt. 2, pp. 1—290.

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D. 6.

# Euphausiacea.

By

## Johan T. Ruud.

With 22 figures and 20 tables in the text.

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# I. INTRODUCTION.

The euphausiid material which the late Professor Dr. Johs. Schmidt passed on to me for investigation was mainly collected on expeditions with the S/S "Thor" in the Atlantic Ocean south-west and south of Ireland in 1905 and 1906 and in the Mediterranean and the Atlantic during the winter of 1908—1909 and the summer of 1910. A minor part of the material was collected by other vessels in the Atlantic and Mediterranean in 1911 and 1912.

The complete list of all stations during these expeditions is given by Schmidt (1912) in "The Introduction" to this series. There is also to be found a description of the gear employed.

The majority of catches were made with "Petersen's Young-fish Trawl", in 1905 and 1906 mostly with a diameter of 330 cm. (Y. 330) and in 1908—1909 and 1910 with a 200 cm. diameter (Y. 200). On the Mediterranean expeditions some catches were also made with a "Ringtrawl" of a diameter of 200 or 150 cm. (C. 200, C. 150). These latter which, in contrast with the young-fish trawl, can be closed before hauling in, were for the most part employed at greater depths.

In 1911 and 1912 a stramin net was used, the diameters being 100, 150 and 200 cm. (S. 100, S. 150, S. 200).

All this gear is made with a stramin[1] in the fishing part which has about 20 threads to 3 cm.

Only two samples of euphausiids were taken in other gear, namely, two samples taken at the surface in an open conical silk net, 100 cm. in diameter, silk gauze No. 3 (P. 100).

The list of stations shows that gear Y. 200, Y. 330, C. 150, C. 200, S. 100, S. 150 and S. 200 were used at 349 out of the total 433 stations taken. Only 222 stations, however, are positive in regard to euphausiids. These positive stations, as the accompanying table shows, are distributed among the various areas and years:

Table 1.

| Year | Atlantic | Mediterranean | | Total number of stations |
|---|---|---|---|---|
| | | Western | Eastern | |
| 1905 | 1 | | | 1 |
| 1906 | 19 | | | 19 |
| 1908—1909 | 16 | 31 | 9 | 56 |
| 1910 | 28 | 51 | 24 | 99 |
| 1911 | 9 | 7 | 7 | 23 |
| 1912 | | | 1 | 1 |
| Total | 91 | 89 | 40 | 222 |

*As belonging to the western Mediterranean I reckon the Straits of Gibraltar and Messina, otherwise I have used the limits between the areas which are defined by Schmidt (loc. cit.).*

*Petersen's young-fish trawl is a more effective gear for taking euphausiids than the open stramin net. For this reason the results for 1911 and 1912 are not quite comparable with the results of earlier years. More-*

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[1] *Stramin is a coarse canvas made of hemp.*

over, the hauls of 1911 and 1912 were only taken in the upper water layers, mostly with 40 metres of wire or less, only individual hauls being taken deeper down to 132 metres of wire. This is undoubtedly the reason for so many stations, 47 out of 71, being negative in respect of euphausiids during these years.

In the Mediterranean from 1908 to 1912 156 stations in all were taken, at which the gear mentioned above was used. Of these stations 129 are positive and 27 negative in respect of euphausiids, but of the 27 only 5 were taken in the open sea and 22 near to the coast within the isobath for 200 metres.

All our samples are from horizontal hauls, and SCHMIDT (loc. cit.) states that during towing the gear was, for the most part, at a depth of slightly more than one-half of the length of wire used. Furthermore, the great majority of the hauls were taken at night. All samples were fixed in 4 % formalin and transferred to alcohol.

The majority of samples have been analysed by me in the manner that all species were first sorted into dishes and each species subsequently total counted. Only a very few of the samples were so large as to necessitate analysis into sub-samples and subsequent calculation of the number. In many cases the material was in poor condition owing to shrivelling due to loss by evaporation of the preservative, but even among such samples the species, as a rule, could be determined with certainty and counted. In some of the samples, however, the material was so damaged that it was necessary to rest content with a partial analysis and a rough estimate of the number of the individual species.

The majority of euphausiids, as we know, have a tendency to shoaling, but when horizontal hauls are of long duration, as most of them were in this case, the samples nevertheless have a considerable representative value. In Table I (at the end of the paper) the total numbers for each species in each sample are given, in the tables in the text (Tables 5—20) the numbers of each species are reduced to hauls of the same duration, namely to a half-hour haul. In these latter tables I have calculated, in respect of each individual area investigated, the average number per half-hour haul in the various depths and for the area as a whole. For the purpose of this calculation only those hauls have been considered which were positive for the species in question. A certain significance therefore attaches to the manner in which the hauls were taken. During the Mediterranean expeditions, however, fishing was carried on to the greatest possible extent at certain standard depths, namely with the following lengths of wire: 25 metres, 65 metres, 300 metres, 600 metres, 1000 metres and, in addition, some deeper hauls. At stations at which these standard depths were deviated from, wire lengths were mostly used which approximated to the usual, in such a manner that the gear fished in nearly the same water layer. In the tables in the text, therefore, I have combined the hauls into three groups: 1) hauls with 65 m. wire or less; 2) hauls with 100—400 m. of wire and 3) hauls with more than 500 m. of wire. Samples from hauls in these groups should thus have been taken: 1) above a depth of 35 m.; 2) between 50 and 200 m. and 3) below 250 m.

For the investigation of this great mass of material, which comprises in all 752 bottles, I have received from Professor JOHAN HJORT financial support for the employment of an assistant, and Mrs. ESTER HORN, cand. mag. has helped me with determinations, counting and the drawing up of the tables. The determinations have been repeatedly controlled by me, and in the case of some individual species I have verified each particular determination. I have had the great advantage of discussing the results with my friend Dr. HJ. BROCH.

ZIMMER (1926) takes into account 80 species of euphausiids distributed among 11 genera. In the present material 27 species occur distributed among 9 genera. All 27 species have been taken in the Atlantic, but only 13 of them also in the Mediterranean. From the Mediterranean COLOSI has described two species, which are not found in our material, namely, *Euphausia messanensis* (COLOSI 1916) and *Meganyctiphanes Calmani* (COLOSI 1918). If these two can be maintained as valid species they must be very rare; in any event judging by our material. I will later on return to this in discussing the individual species. According to earlier literature (vide COLOSI 1922) *Nematoscelis microps* (G. O. SARS) also occurs in the Mediterranean, but, as I will subsequently show, our material indicates that, in any case, it can scarcely be stationary there.

Table 2.

| Species | Atlantic | | Mediterranean |
|---|---|---|---|
| | S.W. Ireland | Cadiz Bay | |
| 1. *Bentheuphausia amblyops* (G. O. Sars) | + | .. | .. |
| 2. *Thysanopoda obtusifrons* (G. O. Sars) | .. | + | .. |
| 3. *Thysanopoda aequalis* (H. J. Hansen) | + | + | + |
| 4. *Thysanopoda acutifrons* (Holt & Tattersall) | + | + | .. |
| 5. *Thysanopoda microphthalma* (G. O. Sars) | .. | + | .. |
| 6. *Thysanopoda pectinata* (Ortmann) | .. | + | .. |
| 7. *Meganyctiphanes norvegica* (M. Sars) | + | + | + |
| 8. *Nyctiphanes couchii* (Bell) | + | + | + |
| 9. *Euphausia krohnii* (Brandt) | + | + | + |
| 10. *Euphausia brevis* (H. J. Hansen) | + | + | + |
| 11. *Euphausia hemigibba* (H. J. Hansen) | + | + | + |
| 12. *Euphausia gibboides* (Ortmann) | .. | + | .. |
| 13. *Thysanoessa inermis* (Krøyer) | + | .. | .. |
| 14. *Thysanoessa longicaudata* (Krøyer) | + | .. | .. |
| 15. *Thysanoessa gregaria* (G. O. Sars) | .. | + | + |
| 16. *Nematoscelis megalops* (G. O. Sars) | + | + | + |
| 17. *Nematoscelis tenella* (G. O. Sars) | .. | + | .. |
| 18. *Nematoscelis microps* (G. O. Sars) | .. | + | .. |
| 19. *Nematoscelis atlantica* (H. J. Hansen) | .. | + | + |
| 20. *Nematobrachion boopis* (Calman) | + | + | .. |
| 21. *Nematobrachion flexipes* (Ortmann) | .. | + | .. |
| 22. *Stylocheiron carinatum* (G. O. Sars) | .. | + | .. |
| 23. *Stylocheiron elongatum* (G. O. Sars) | .. | + | .. |
| 24. *Stylocheiron longicorne* (G. O. Sars) | + | + | + |
| 25. *Stylocheiron suhmii* (G. O. Sars) | .. | + | + |
| 26. *Stylocheiron maximum* (H. J. Hansen) | + | + | + |
| 27. *Stylocheiron abbreviatum* (G. O. Sars) | + | + | + |

In Table 2 above I have entered the 27 species which are found in the material, with an indication of the area in which they are found.

In all, 15 species were taken in the area south-west of Ireland, 3 species only there; 24 species in Cadiz Bay, 9 species only there, and 13 species in the Mediterranean. Of these 13, 10 species have been taken in both the Atlantic areas, 3 species only in Cadiz Bay.

# II. ON THE DETERMINATION OF THE SPECIES.

The descriptions of the 27 species which occur in the material are to be found scattered throughout an extensive literature. I have, therefore, considered it expedient below to review each species in respect of its determination with a reference to the publications for which there may specially be use. In addition I append information regarding my own observations of value for the determination.

## I. Genus **BENTHEUPHAUSIA** G. O. Sars.

There is only one species of this genus:—

### 1. **Bentheuphausia amblyops** G. O. Sars.

*Thysanopoda(?) amblyops* G. O. Sars 1883.
*Bentheuphausia amblyops* G. O. Sars 1885.
*Bentheuphausia amblyops* Zimmer 1909.

This species is so characteristic that it is easily determined from the description and drawings which are given in "Nordisches Plankton" (Zimmer, 1909).

## II. Genus **THYSANOPODA** H. Milne-Edwards.

5 of the 11 species of this genus are included in the material. In accordance with H. J. Hansen (1905, II) it is expedient to divide them into 2 groups, a and b:—

a. Species with lateral denticles near the posterior end of carapace.

### 2. **Thysanopoda obtusifrons** G. O. Sars.

*Thysanopoda obtusifrons* G. O. Sars 1883.
*Thysanopoda obtusifrons* G. O. Sars 1885.
*Thysanopoda vulgaris* H. J. Hansen 1905, I.
*Thysanopoda obtusifrons* H. J. Hansen 1910.

### 3. **Thysanopoda aequalis** H. J. Hansen.

*Thysanopoda obtusifrons* Lo Bianco 1901.
*Thysanopoda obtusifrons & microphthalma* Lo Bianco 1903.
*Thysanopoda aequalis* H. J. Hansen 1905, II.
*Thysanopoda aequalis* var. *latifrons* Colosi 1916.

These two species are easily distinguished by the characteristic form of the lobe from the first antennular joint (vide H. J. Hansen, 1905, II, *T. aequalis* and *T. vulgaris*. Figures, vide H. J. Hansen 1910, Pl. XIII. Fig. 1 and H. J. Hansen 1912, Pl. 4, Fig. 5).

b. Species without lateral denticles in carapace in adult and sub-adult specimens.

### 4. **Thysanopoda acutifrons** Holt & Tattersall.

*Thysanopoda acutifrons* Holt & Tattersall 1905, I, Pars.
*Thysanopoda pectinata* H. J. Hansen 1905, I.
*Thysanopoda acutifrons* Zimmer 1909.

### 5. **Thysanopoda microphthalma** G. O. Sars.

*Thysanopoda microphthalma* G. O. Sars 1883.
*Thysanopoda microphthalma* G. O. Sars 1885.
*Thysanopoda distinguenda* H. J. Hansen 1905, I & II.
*Thysanopoda acutifrons* Holt & Tattersall 1905, I, Pars.
*Thysanopoda distinguenda* Zimmer 1909.
*Thysanopoda microphthalma* H. J. Hansen 1910.

### 6. Thysanopoda pectinata Ortmann.

*Thysanopoda pectinata* Ortmann 1893.
*Thysanopoda foliifera* Illig 1909.
*Thysanopoda pectinata* H. J. Hansen 1912.

These three species are also distinguished by the shape of the lobe from the first antennular joint and, as far as the males are concerned, by the shape of the endopodite of the first pair of pleopods (Vide H. J. Hansen 1905, I, Zimmer, 1909, H. J. Hansen 1910, page 85, text Fig., H. J. Hansen, 1912, Pl. 5, Fig. 1).

## III. Genus MEGANYCTIPHANES Holt & Tattersall.

Zimmer counts with two species of this genus, inasmuch as he includes *Meganyctiphanes Calmani* established by Colosi in 1916 after a find in the Strait of Messina. As far as I can understand, this species has not been found since. On Colosi's description of *M. Calmani* I must make the following comment:

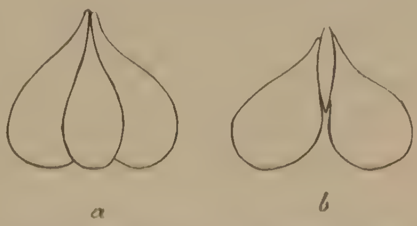

Fig. 1. Thelycum of *M. norvegica* (a) and *M. Calmani* (b). (× 29) (After Colosi).

In the case of the females *M. Calmani* as a particular species is based upon an untenable character, namely the shape of the thelycum.

Colosi reports that *M. Calmani* has two lateral lobes in the thelycum, while *M. norvegica* in addition to these has a median lobe. I reproduce here Colosi's schematic drawing of these characteristics.

On a previous occasion I have examined the thelycum in many specimens of *M. norvegica* from the west coast of Norway and other boreal and Arctic waters (Hjort & Ruud 1929), and on the present occasion I have examined many females from the Mediterranean and the Atlantic Ocean. I have found, however, that in *M. norvegica* the thelycum always consists only of two lateral lobes. This is also described by Raab (1915) in the following manner: — "Bei jungen Weibchen von *Meganyctiphanes* mit noch nicht ausgebildetem Ovarium sah ich immer nur die beiden lateralen Platten . . ." (page 19). In the meantime it further proceeds that he (Raab) is of the opinion that in mature females of *Meganyctiphanes* there is found a thelycum which agrees with the thelycum in *Euphausia krohnii* (and *Euphausia superba*, vide Zimmer 1913, Ruud 1932) in that, from the sternite a median lobe is formed which, ventrally and caudally, entirely covers the fissure between the ventral lobes. If this view of the thelycum's formation were correct, the difference between *M. norvegica* and *M. Calmani* which Colosi describes could only be regarded as a difference between mature and immature females. My investigations, however, show that in *M. norvegica* no large median lobe is ever formed from the sternite, but only an indication in the shape of a protruberance caudally of the thelycum. The fissure between the two median lobes is always open ventrally, and thus far also Raab is guilty of a misunderstanding. In fertilised females, however, the space between the lateral lobes is always filled with a concretion of spermatozoa, and this produces a picture which is very reminiscent of that shown by Colosi in his schematic drawing. I here reproduce a couple of my own drawings from material from the west coast of Norway, which clearly illustrate this circumstance.

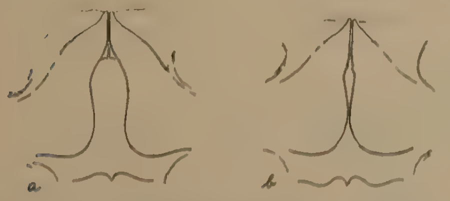

Fig. 2. Thelycum of *M. norvegica*. a. From a mature and impregnated female, (the remains of the spermatophores are taken away), b. from a mature but virginal female. (× 22). (Specimens from the Norwegian west coast, 1928).

In my opinion the difference which Colosi has pointed out must only be regarded as a difference between virginal and fertilised females.

In contrast to many other euphausiids the empty spermatophores easily fall off in the case of *M. norvegica*, only the concretion of spermatozoa remaining embedded between the two lateral lobes of the thelycum. But this spermatozoan concretion can easily be loosened with a needle or pincette, without damage to the thelycum. In *Euphausia superba* where, otherwise, the spermatophores are often found, I have previously taken the presence of such a spermatozoan concretion to be a criterion that the animal was a fertilised female (Ruud 1932).

In the male of *M. Calmani* Colosi found some small additional processes in the copulatory organ on the first pleopod which distinguished this species from *M. norvegica*. In none of the many males which I have examined from the Mediterranean or other waters have I found these characters formed.

It seems to me to be doubtful if *M. Calmani* can be maintained as a valid species when the specific characters which were alleged for the female fall, and when the male is to be determined on characters the variation of which has not been investigated. Personally, I have arrived at the opinion that the formation of the endopodite on the first pleopod in the males is of great value in the determination in addition to other specific characters, but the formation of the male pleopods or the thelycum in the females must not, by themselves, be invested with too great a measure of importance. The circumstance alone that the development of both organs is dependent on the degree of maturity of the individuals is a decisive argument in support of such an opinion. In our material *M. norvegica* is, in any case, the only species of this genus which has been found.

### 7. Meganyctiphanes norvegica M. Sars.

*Thysanopoda norvegica* M. Sars 1856.
*Nyctiphanes norvegica* G. O. Sars 1883.
*Meganyctiphanes norvegica* Holt & Tattersall 1905, I.
*Euphausia lanei* Holt & Tattersall 1905, I.
*Meganyctiphanes norvegica* Zimmer 1909.
*Euphausia lanei* Zimmer 1909.
?*Meganyctiophanes Calmani* Colosi 1918.

For a complete synonymy vide Denis 1920. This characteristic species is easily determined from "Nordisches Plankton", Zimmer 1909.

## IV. Genus NYCTIPHANES G. O. Sars.

According to the literature this genus has 5 species, but only one is known from the area investigated and is found in our material.

### 8. Nyctiphanes couchii Bell.

*Thysanopoda Couchii* Bell 1853.
*Nyctiphanes couchii* Zimmer 1909.

The species is easily determinable from "Nordisches Plankton", Zimmer 1909.

## V. Genus EUPHAUSIA Dana.

At the present time 30 valid species are counted as belonging to this genus, of which 4 are found in our material. I have not been able to find *Euphausia messanensis* (Colosi 1916). This species Colosi described from the Straits of Messina after a find of two males, but the females are unknown. The *E. messanensis* male deviates from *E. gibba* (G. O. Sars) only in a couple of minor characters. With regard to this Colosi himself says (loc. cit. page 67) "Presenta notevoli rassomiglianze con *E. gibba*, ma se ne distacca per la peculiare conformazione dei peduncoli antennulari, per la presenza di una spina anale semplice anzichè bidentata, per la maggiore lunghezza del lobo mediano dell'organo copulatore rispetto ai processi del lobo interno."

In the Mediterranean the species might possibly be confused with *E. hemigibba* (H. J. Hansen), but I have controlled a large number of males of the latter without succeeding in finding any which could be other than *E. hemigibba*. The magnitude of our material must, therefore, at least justify us in the conclusion that *E. messanensis* must be exceptionally rare.

If we keep to the grouping for the genus *Euphausia* used by H. J. Hansen (1911) our four species belong to groups a and c.

a. Species with two pairs of lateral denticles on the carapace. No dorsal process on third to fifth abdominal segment.

### 9. Euphausia krohnii Brandt.

*Thysanopoda Krohnii* Brandt 1851.
*Euphausia Mülleri* Claus 1863.
*Euphausia pellucida* G. O. Sars 1885. Pars.
*Euphausia Mülleri* H. J. Hansen 1905, II.
*Euphausia mülleri* Zimmer 1909.
*Euphausia krohnii* H. J. Hansen 1910.

For a full synonymy vide Colosi 1917, 1922, Denis 1920. It is easily determined from "Nordisches Plankton" Zimmer 1909.

### 10. Euphausia brevis H. J. Hansen.

*Euphausia brevis* H. J. Hansen 1905, II.
*Euphausia brevis* H. J. Hansen 1912.

For full synonymy vide Tattersall 1924. Prior to 1905 *E. krohnii* and *E. brevis* were placed together, from the Mediterranean, for example, as *Euphausia pellucida* by Lo Bianco, (1901, 1903). The two species are easily distinguished by the shape of the lobe from the first antennular joint and by the fact that *E. brevis* has noticeably smaller eyes than *E. krohnii*. In the case of the males the formation of the endopodite on the first pair of pleopods is also characteristic. For descriptions and figures vide Hansen 1905, II, Zimmer 1909, Hansen 1911 and Hansen 1912 (Pl. 8, Fig. 1).

*Euphausia krohnii* can easily be confused with *Euphausia americana* (H. J. Hansen), which is also known from the Atlantic Ocean. Here also the lobe from the first antennular joint is the best character for determination. (Vide Hansen, 1911, pages 22 and 23). I have not been able to find *Euphausia americana* in our material.

c. Species with a single pair of lateral denticles on the carapace. A dorsal process from hind margin of third abdominal segment.

### 11. Euphausia hemigibba H. J. Hansen.

*Euphausia gibba* Lo Bianco 1901.
*Euphausia gibba* Lo Bianco 1903.
*Euphausia gibba* Tattersall 1909.
*Euphausia hemigibba* H. J. Hansen 1910.

They are easily determined from a description and good figures by Hansen 1910, page 100, Pl. XIV, Fig. 5.

### 12. Euphausia gibboides Ortmann.

*Euphausia gibboides* Ortmann 1893.
*Euphausia gibboides* H. J. Hansen 1912.

A description and good figures by Hansen (loc. cit.) page 253, Pl. 9, Fig. 2.

These two species are easily distinguished by the form and equipment of the antennulæ, by the size of the eyes and by the formation of the endopodite on the first pair of pleopods in the males.

## VI. Genus THYSANOESSA Brandt.

Of the 9 species of this genus 3 are found in the material.

### 13. Thysanoessa inermis Krøyer.

*Thysanoessa inermis* Zimmer 1909. (With synonyms.)
*Thysanoessa neglecta* Zimmer 1909. (With synonyms.)
*Thysanoessa inermis* H. J. Hansen 1911.

### 14. Thysanoessa longicaudata Krøyer.

*Thysanoessa longicaudata* Zimmer 1909. (With synonyms.)
*Thysanoessa longicaudata* H. J. Hansen 1911.

### 15. Thysanoessa gregaria G. O. Sars.

*Thysanoessa gregaria* G. O. Sars 1883.
*Thysanoessa gregaria* G. O. Sars 1885.
*Thysanoessa gregaria* Zimmer 1909.
*Thysanoessa gregaria* H. J. Hansen 1911.

These three species can be determined from "Nordisches Plankton" Zimmer (loc. cit.) and in his paper of 1911 H. J. Hansen has provided a good key to determination. The determination causes no difficulty. Only *T. gregaria* can be confused with *Thysanoessa parva* H. J. Hansen, which is also known from the Atlantic Ocean. (Vide H. J. Hansen 1905, I & II). *T. parva* is not found in the present material.

## VII. Genus NEMATOSCELIS G. O. Sars.

Of this genus 7 species are known, of which 4 are found in the material. The genus corresponds in many characters with the genus *Thysanoessa*, the main difference being found in the greatly elongated first pair of thoracic legs (2nd cormopode pair), but as these legs have often fallen off at the base, the determination is made difficult. The base for the first pair of legs, however, is considerably greater in *Nematoscelis* than in *Thysanoessa* and this relative character is most often serviceable for determination of genus. Furthermore, there are the specific characters which must always be taken into account in the determination when the first pair of legs are missing. All species of the genus have a characteristic sex dimorphism in the shape of the rostrum and antennulæ.

In his papers of 1910 and 1911 H. J. Hansen divides the genus *Nematoscelis* into two groups a and b and gives in the 1910 paper a serviceable key to determination of the species.

a. Maxillulae with a pseudexopod well developed. First elongate pair of legs with long spines both from the terminal joint and from the distal angle of the penultimate joint. Second to fifth pair of legs with the full number of joints, therefore three joints beyond the knee. No lateral denticles on carapace.

### 16. Nematoscelis megalops G. O. Sars.

*Nematoscelis megalops* G. O. Sars 1883.
*Nematoscelis megalops* G. O. Sars 1885.
*Nematoscelis megalops* H. J. Hansen 1905, I.
*Nematoscelis megalops* Zimmer 1909.
*Nematoscelis megalops* H. J. Hansen 1910.
*Nematoscelis megalops* H. J. Hansen 1911.

The species is easily determined from ZIMMER (loc. cit.) and there are good figures in the paper by SARS from 1885. (Pl. XXIII and XXIV.)

b. Maxillulae without pseudexopod. First pair of legs with long spines only from the terminal joint. Second and third pairs of legs with but two joints beyond the knee. Immature specimens of both sexes and mature males have lateral denticles in the margin of carapace.

### 17. Nematoscelis tenella G. O. Sars.

*Nematoscelis tenella* G. O. Sars 1883.
*Nematoscelis tenella* G. O. Sars 1885.
*Nematoscelis mantis* Chun 1896.
*Nematoscelis tenella* H. J. Hansen 1905, II.
*Nematoscelis tenella* H. J. Hansen 1910.

The best character for determination of this species is the shape and size of the eyes. Good figures by H. J. HANSEN 1910 (Pl. XV, Fig. 4).

### 18. Nematoscelis microps G. O. Sars.

*Nematoscelis microps* G. O. Sars 1883.
*Nematoscelis microps* G. O. Sars 1885.
*Nematoscelis rostrata* G. O. Sars 1885.
*Nematoscelis microps* H. J. Hansen 1910.

Descriptions and good figures by H. J. HANSEN 1910, Pl. XV, Fig. 2, and H. J. HANSEN 1912, Pl. 10, Fig. 1.

TATTERSALL (1909), COLOSI (1922) and others give *Nematoscelis mantis* Chun as a synonym for *N. microps*, but an examination of CHUN's drawings and description make it undoubted that it is *N. tenella* with which he was dealing.

### 19. Nematoscelis atlantica H. J. Hansen.

*Nematoscelis atlantica* H. J. Hansen 1910.

The complete description of this species is not yet available as HANSEN postponed it to a later paper in the Monaco series. The characters which are mentioned in the "Key to the species" in the above-mentioned paper, however, are sufficient to enable the species to be identified with certainty.

I have not been able to find any other differences between *N. microps* and *N. atlantica* than those which are mentioned by Hansen, the difference between the size of the eyes and between the first pair of pleopods of the males. The following are H. J. Hansen's (loc. cit. page 107) points B, $\alpha$ and $\beta$ in "key to the species":—

"$\alpha$. Proximal process slender, acute, diaphaneous, not longer, or even a little shorter than the terminal process, which considerably overreaches the spine-shaped process. (Eyes in both sexes somewhat smaller than in *N. microps*)........... *N. atlantica* n. sp."

"$\beta$. Proximal process rather thick, obtuse, generally opaque, considerably longer than the terminal process which is shorter than the spine-shaped process... *N. microps* G. O. Sars."

Zimmer (1915) showed by drawings that young males of *N. microps* according to the endopodite of the first pair of pleopods can so resemble mature males of *N. atlantica* as to be mistaken for them, a circumstance which makes determination with certainty even more difficult. In our material, however, I have found that the proximal process even in young males of *N. microps* is also more strongly developed than in *N. atlantica*. Zimmer, however, says (loc. cit. page 314) "... dass man zur Bestimmung immer noch das Merkmal der Augengrösze sehr stark mit in Rücksicht ziehen muss." In the case of the females the size of the eye remains the only character which can be used.

In sifting the present material I very soon came to the conclusion, however, that this relative character can only be determined with certainty by measuring. The size of the eye, measured for example by one of its diameters does not stand in either of these two species in any definite relation to the length of the animal, but varies with this length. I found it therefore practical to measure the carapace-length of the animal in proportion to the eye and to compare this proportionate figure with the carapace length. I have taken the measurements in the manner shown in Fig. 3.

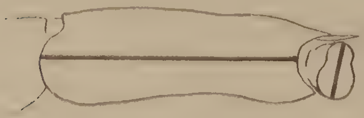

Fig. 3. The measurements taken from *N. microps* and *N. atlantica*.

In order to obtain accurate measurements of the greatest diameter of the eye the latter must, as a rule, be taken out and be measured by itself. From a series of such measurements I reproduce Table 3 in which I have measured males of *N. microps* and *N. atlantica* all of which were first determined to species by the endopodite of the first pair of pleopods. The measurements are given in the units which the measuring ocular gave in this case, namely, one scale division = 0.055 mm.

**Table 3.**

S/s Thor, St. 91.18—VI—1910. Cadiz Bay.

| *Nematoscelis microps* ♂ | | | *Nematoscelis atlantica* ♂ | | |
|---|---|---|---|---|---|
| Carapace (C) | Eye (E) | Carapace/Eye (C/E) | Carapace (C) | Eye (E) | Carapace/Eye (C/E) |
| 62 | 20 | 3.10 | 55 | 16 | 3.45 |
| 61 | 19 | 3.20 | 58 | 17 | 3.40 |
| 56 | 19 | 2.95 | 55 | 17 | 3.25 |
| 61 | 20 | 3.05 | 55 | 16 | 3.45 |
| 62 | 20 | 3.10 | 59 | 17 | 3.45 |
| 62 | 20 | 3.10 | 60 | 17 | 3.50 |
| 60 | 20 | 3.00 | 61 | 17 | 3.60 |
| 59 | 19 | 3.10 | 56 | 16 | 3.50 |

In all 20 *N. atlantica* were measured at this station, but the eight referred to above are sufficient to show that the difference is obvious. For *N. microps* the proportion C/E (Carapace/Eye) does not exceed 3.20 and for *N. atlantica* it is not below 3.25.

In order, however, to find a method which could be extended to comprehend animals of all carapace lengths and of both sexes, I have found it practical to set out all measurements on millimetre scale paper,

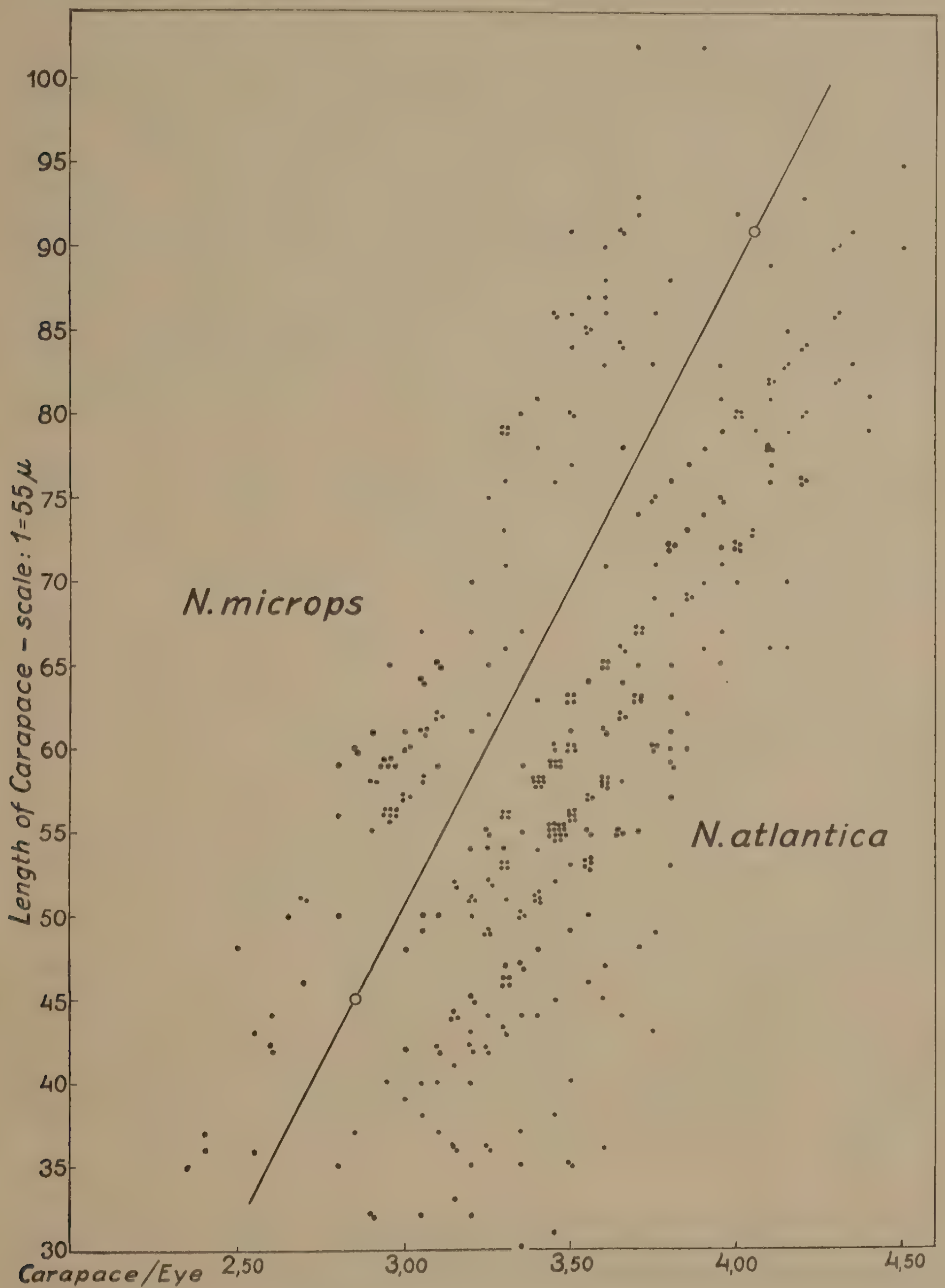

Fig. 4. The relation between length of Carapace and the index "Carapace/eye" in *N. microps* and *N. atlantica*.

with the carapace length as an ordinate and the corresponding proportion C/E as an abscissa. The determination thereby becomes graphical and entirely objective. At first all individuals of both species were measured in this manner, but as I gradually became more practised it was possible to sort out the two species in advance and to verify the determination by measurements. In the end this was only done with samples taken at random, as my determination in advance always proved to be correct. Where a species was found by itself measurements were always made to check the determination. In Fig. 4 the results of my graphical determination of species is given. The material comprehends in all 107 measured *N. microps* and 289 *N. atlantica*.

It will be seen that the measurements are distributed into two plainly separated groups and confirm that, even if the eye does not grow proportionately with the carapace, nevertheless for every carapace-length, the eye is greater in *N. microps* than in *N. atlantica*. As far as that is concerned, it might seem sufficient in a graphical investigation to employ the carapace-length and the diameter of the eye to establish the identity of the species, but on account of the measurement units employed the result is not so clear as by the use of the C/E index. The observations in Fig. 4 are completely separated by a straight line drawn through the points: ($C = 45$, $C/E = 2.85$), ($C = 91$, $C/E = 4.05$). With the same carapace-length, in other words, *N. microps* has a smaller, and *N. atlantica* a greater, index (C/E) than this line denotes. The observations are evenly divided on both sides of this line. I have added up all observations which have the same distance from the line and thus obtained two series of frequency distributions which resolve themselves as shown in Table 4.

**Table 4.**

Distance from the line of separation in Fig. 4.

| Distance | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *N. atlantica:* | | | | | | | | | | | | | | | | | | | | |
| Frequency | 0 | 6 | 13 | 16 | 44 | 24 | 30 | 38 | 33 | 18 | 20 | 8 | 9 | 4 | 4 | 6 | 1 | 0 | 3 | 3 |
| *N. microps:* | | | | | | | | | | | | | | | | | | | | |
| Frequency | 1 | 8 | 4 | 20 | 21 | 13 | 11 | 12 | 13 | 2 | 0 | 1 | 1 | .. | .. | .. | .. | .. | .. | .. |

I consider this graphic method the only reliable method for the separation of the two species *N. microps* and *N. atlantica*. As far as the females and young males are concerned it is also the only one which can be used, and in the case of the mature males it is considerably easier than the process involving dissection of the endopodite on the first pair of pleopods and an examination of this by means of a considerable enlargement. However, both of these methods should here be used for purposes of control. With a large material comprising both species a certain dexterity can gradually be acquired in separating the two species immediately, but where one of these two species is found alone it is more difficult to do so.

In separating the two species in other material, I must most definitely dissociate myself from any use of the line which I have found in my measurement work. In this connection we have still too little knowledge of whether the proportion between carapace and eye may vary differently in different waters, and, in addition, the fixing solution may possibly exert a certain amount of influence. The line of separation must, therefore, for each material first be found empirically by measurement of the greatest number of males determined by means of the endopodite on the first pair of pleopods. If this cannot be done the line will also reveal itself when a sufficient number have been measured and the two groups clearly show up.

## VIII. Genus **NEMATOBRACHION** Calman.

Of the three species of this genus two are included in the material. This genus is characterised by a considerable elongation of the second pair of thoracic legs (3rd cormopode pair). In this character it agrees with the next genus. When the second pair of legs are missing these two genera, therefore, must be distinguished by other characters, such as the shape of the eyes, carapace, antennulæ, etc. In key to the genera ZIMMER (1909, page 4) uses the number of joints on the endopodite of the sixth pair of legs (7th cormopode pair). The genus *Nematobrachion* has 5 joints, the genus *Stylocheiron* 2.

### 20. Nematobrachion boopis Calman.

*Nematobrachion boopis* Zimmer 1909, (with synonymy).
*Nematobrachion boopis* H. J. Hansen 1912.

Descriptions and figures in ZIMMER (loc. cit.) pages 14—16, Fig. 22 and in HANSEN (loc. cit.) Pl. 10 Fig. 4.

### 21. Nematobrachion flexipes Ortmann.

*Nematobrachion flexipes* Ortmann 1893.
*Nematobrachion flexipes* H. J. Hansen 1912.

Vide H. J. HANSEN (loc. cit.) pages 269—272 and Pl. 10, Fig. 5. In the same paper HANSEN also gives a key to the species, (page 266).

In general genus *Nematobrachion* is easily sorted out of the material by the characteristic shape and colour of the eyes, in addition to the appearance of the elongated second pair of legs if these are still present. The two species are easily distinguished by the fact that *N. flexipes* has a simple spiniform process from the hind margin of the third to the sixth abdominal segment.

## IX. Genus STYLOCHEIRON G. O. Sars.

In this genus there are 10 known species of which 6 are included in the material. According to H. J. HANSEN (1910) the genus can be divided into three groups a, b and c, according to the fashioning of the last joint of the elongated second pair of legs. As the second pair of legs are often missing other characters also must be given consideration.

a. Species only with lateral setae on the penultimate joint of the elongated pair of legs.

### 22. Stylocheiron carinatum G. O. Sars.

*Stylocheiron carinatum* G. O. Sars 1883.
*Stylocheiron carinatum* G. O. Sars 1885.
*Stylocheiron carinatum* H. J. Hansen 1910.

Good descriptions and figures in SARS (1885, page 137, Pl. XXVI) and in HANSEN (loc. cit. page 113 Pl. XVI, Fig. 1).

b. Species with the elongated pair of legs terminating in false chelae.

### 23. Stylocheiron elongatum G. O. Sars.

*Stylocheiron elongatum* G. O. Sars 1883.
*Stylocheiron elongatum* G. O. Sars 1885.
*Stylocheiron elongatum* Zimmer 1909.

This species is easily determined from descriptions and drawings in "Nordisches Plankton" (ZIMMER 1909) and is easily recognisable by the extremely long 6th abdominal segment. This is as long as, or longer than, the two preceding segments together.

### 24. Stylocheiron longicorne G. O. Sars.

*Stylocheiron longicorne* G. O. Sars 1883.
*Stylocheiron longicorne* G. O. Sars 1885.

*Stylocheiron mastigophorum* Chun 1896. Pars.
*Stylocheiron Suhmii* H. J. Hansen 1905, I. Pars.
*Stylocheiron longicorne* H. J. Hansen 1908.

For descriptions and figures vide particularly Sars 1885 (page 144, Pl. XXVII, Fig. 5) and H. J. Hansen 1910 (page 120, Pl. XVI, Fig. 5).

### 25. **Stylocheiron suhmii** G. O. Sars.

*Stylocheiron suhmii* G. O. Sars 1883.
*Stylocheiron suhmii* G. O. Sars 1885.
*Stylocheiron mastigophorum* Chun 1896. Pars.
*Stylocheiron longicorne* Zimmer 1909, Fig. 41.
*Stylocheiron suhmii* H. J. Hansen 1912.

Descriptions and figures in Hansen (loc. cit. page 277, Pl. 11, Fig. 3) and in Sars (1885, page 142, Pl. XXVII, Fig. 1—4).

*Stylocheiron longicorne* and *Stylocheiron suhmii* have previously been very much confused with each other and the majority of determinations prior to 1908 or 1910 must be regarded as unreliable. Thus, in "Nordisches Plankton" Zimmer (1909) has published a drawing of *S. suhmii* as an illustration to a description of *S. longicorne*. In papers prior to 1909 Lo Bianco and Tattersall have only declared *S. suhmii* as found in the Mediterranean, and it can almost obviously be assumed that this includes both species. In reality the two species are easy to distinguish by means of the shape and structure of the eyes, but when the eyes are missing, as is frequently the case, an entirely reliable determination is difficult because the other variations which are pointed out in the descriptions are relative, with little value as specific characters.

The eyes of these species are characterised by the fact that the upper part consists of distinctly grouped crystal cones in number constant for each species, but differing from that of other species.

Chun (1896) was of opinion that the number of crystal cones increased with age and he, therefore, regarded *S. suhmii* and *S. longicorne* as young and older individuals respectively of the species *S. mastigophorum*. H. J. Hansen also held the same opinion when he regarded *S. longicorne* as synonymous with *S. suhmii* (H. J. Hansen, 1905. I). Sars' drawings of 1885 (Pl. XXVII) do not illustrate well the difference which there is in the eyes of the two species, whereas Hansen's drawings, on the other hand, (1910, Pl. XVI, Fig. 5a, 1912, Pl. 11, Fig. 3a) are good. When the eyes are regarded in a lateral view *S. longicorne* has 9—10 crystal cones in the upper half of the eye and *S. suhmii* 3 crystal cones. (Vide Fig. 5).

*S. microphthalma* and *S. affine* which were described by Hansen in the paper of 1910 have respectively 2 & 4—5 crystal cones in the upper part of the eye, but otherwise these species resemble *S. longicorne* and *S. suhmii* to the point of being mistaken for them. *S. microphthalma* and *S. affine*, however, are both Indo-Pacific.

c. Species with the elongated pair of legs terminating in real chelae with a well developed immoveable finger from the penultimate joint.

### 26. **Stylocheiron maximum** H. J. Hansen.

*Stylocheiron maximum* H. J. Hansen 1908.
*Stylocheiron maximum* Zimmer 1909.
*Stylocheiron maximum* H. J. Hansen 1910.
*Stylocheiron maximum* H. J. Hansen 1912.

### 27. Stylocheiron abbreviatum G. O. Sars.

*Stylocheiron abbreviatum* G. O. Sars 1883.
*Stylocheiron abbreviatum* G. O. Sars 1885.
*Stylocheiron chelifer* Chun 1896.
*Stylocheiron abbreviatum* Zimmer 1909.
*Stylocheiron abbreviatum* H. J. Hansen 1910.
*Stylocheiron abbreviatum* H. J. Hansen 1912.

These two species were certainly, to a great extent, jumbled together as *S. abbreviatum* or *S. chelifer* before H. J. Hansen described *S. maximum* in 1908. Determinations originating from prior to that date must, therefore, be regarded as uncertain. The main differences between these two species were pointed out by Hansen in his descriptions of 1908 and 1910. In the paper of 1910 (Pl. XVI, Fig. 6) he provides good figures of *S. maximum* and in the paper of 1912 (Pl. 11, Fig. 5) good figures of *S. abbreviatum*. In "Nordisches Plankton" (Zimmer loc. cit.) only figures of *S. abbreviatum* are found. A beautiful drawing of this is also to be found in Chun (loc. cit. Taf. XI, Fig. 1—8 *S. chelifer*). The shape of the eye is a good character for distinguishing these two species from each other. In *S. maximum* the upper half of the eye is just as wide, or nearly just as wide, as the lower part. In *S. abbreviatum* the upper part of the eye is considerably narrower and lower than the lower part (Vide, Fig. 5). Furthermore, *S. abbreviatum* has a distinct dorsal tooth in the margin of the 4th and 5th abdominal segment whereas these are lacking in *S. maximum*. Moreover, *S. maximum* has a relatively smaller and longer 6th abdominal segment than *S. abbreviatum*.

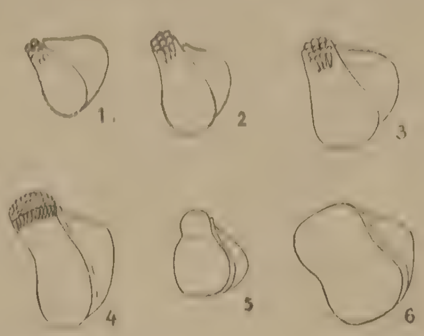

Fig. 5. Lateral view of the eye of *Stylocheiron*-species: 1. *S. microphthalma*, 2. *suhmi*, 3. *S. affine*, 4. *S. longicorne*, 5. *S. abbreviatum*, 6. *S. maximum*. (1—4 × 23, 5 & 6 × 9) (After drawings by H. J. Hansen).

In the accompanying Fig. 5 I have grouped the eyes in the various *Stylocheiron* species taken from the papers of H. J. Hansen already mentioned.

# III. ON THE BIOLOGY OF THE SPECIES.

### 1. Bentheuphausia amblyops G. O. Sars.

*Bentheuphausia amblyops* is a distinctly deep water form and has, therefore, a very extensive distribution. It is taken in sub-tropical and tropical waters in all three oceans. Hansen (1912) gives its distribution in the Atlantic as from 46°15′ N. Lat. to close to Tristan da Cunha in the south. South of Australia it is taken up to 50° S. Lat. (Sars 1885).

In our material the species was taken at stations 74, 178, 180 and 181 in 1906, in all, 9 specimens from 5 stations. All were taken in hauls with 1800 or 2000 metres of wire, in other words, probably at a depth of about 1000 metres. *Bentheuphausia* has also previously been taken in this area south-west of Ireland. Our finds, therefore, make no new contribution to the knowledge of the distribution of this rare species.

### 2. Thysanopoda obtusifrons G. O. Sars.

This species has previously been taken in the Atlantic Ocean near the Azores, in the Sargasso Sea and in the northern and southern equatorial current. Zimmer (1914) found it from 20°41′ N. Lat. to 32°8′

S. Lat. in the Atlantic Ocean. Outside of the Atlantic it has been taken west of Australia and north of New Zealand. TATTERSALL (1924) sums up this to mean that *T. obtusifrons* is a tropical and sub-tropical form with a wide distribution. In our material only one individual was taken, in Cadiz Bay, Station 232, 100 metres of wire (9/9/1910).

### 3. Thysanopoda aequalis H. J. Hansen.

*Thysanopoda aequalis* is known from tropical and sub-tropical waters in all seas. According to the literature available there is, in any event in the Atlantic Ocean, one area near the Equator where it has not been taken. HANSEN (1912) states that *T. aequalis* is common in the eastern Atlantic between 23° and 36° N. Lat. and in the central Atlantic he indicates it as south to 5° N. Lat. On the Deutsche Süd Polar Expedition *T. aequalis* was not taken between 8°43′ S. 11°55′ W. and 17°28′ N. 29°42′W. (ZIMMER, 1914). On the British Antarctic Expedition it was not taken between 20°30′ S. 36°30′ W. and 27°22′ N. 35°40′ W. (TATTERSALL, 1924). This applies also to *Euphausia brevis* and *Euphausia hemigibba* and we shall, therefore, return to this circumstance later. In the area Chesapeake Bay-Bermuda-Florida TATTERSALL (1926) found that the maximum distribution of *T. aequalis* was at depths between 50 and 150 metres. It is, therefore, counted as belonging to the upper water layers even if it is rarely at the surface.

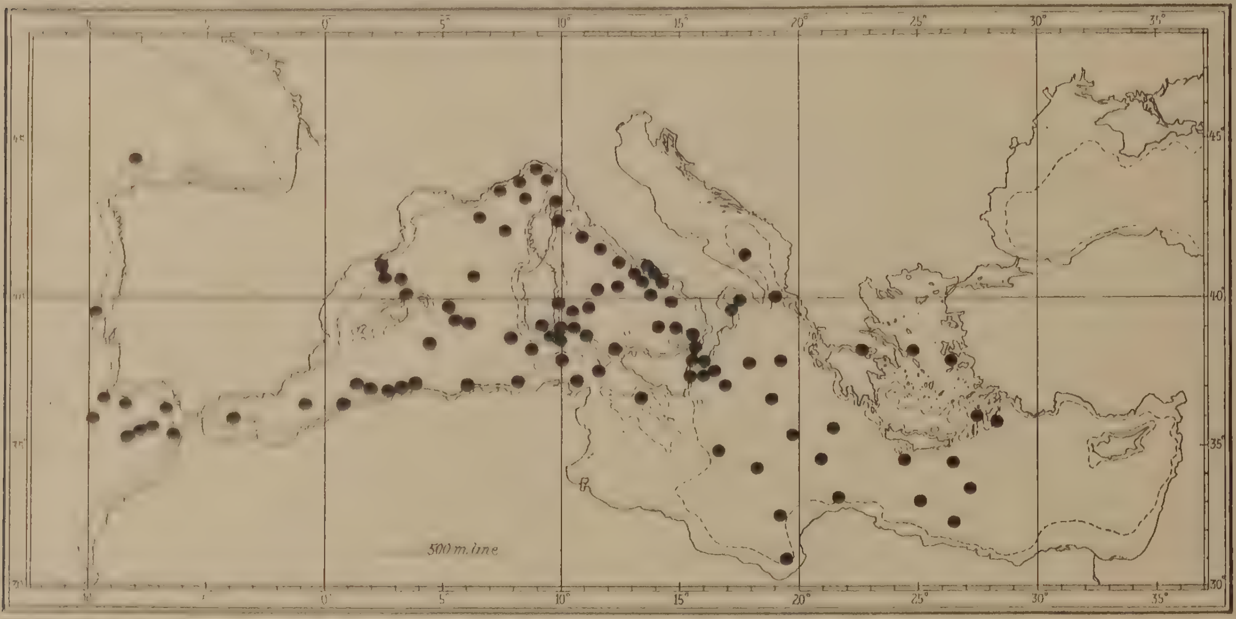

Fig. 6. *Thysanopoda aequalis.* Positive stations 1908—09, 1910, 1911, 1912.

In the 1906 material *T. aequalis* was taken at 6 stations south-west of Ireland, all situated outside of the isobath for 1000 metres (stations 62, 175, 178, 179, 180 and 181). The most northerly find was at station 175, namely 51°11′ N., 11°41′ W. The greatest number was 26 individuals in a one hour haul, and all were taken in hauls with more than 600 metres of wire, the majority in hauls with 1800 metres.

In 1911 *T. aequalis* was taken at 3 of 6 stations in the area west and south-west of Portugal (St. 265, 376 and 377), all in hauls near to the surface, with 15 to 47 metres of wire. At station 376, 242 individuals were taken in a half hour haul.

In the Mediterranean in 1911 and 1912 the species was taken at 13 of 16 stations in hauls with 10 to 132 metres of wire, in part in considerable numbers. In many samples the number has not been determined as, in part, it mainly consisted of larvæ. In the chart Fig. 6 these positive stations in the Mediterranean are set out together with the positive stations from 1908—1909 and 1910.

In the 1908—1909 material *T. aequalis* was taken at 36 out of 56 stations, and in 1910 at 56 of 99 stations and is distributed as shown by Fig. 6. The number varies from 1 in a two hours' haul to 750 in a fifteen minutes' haul. In the accompanying table I have calculated, for the different areas of the Mediterranean, the frequency, that is to say the number of positive stations in respect of *T. aequalis* in comparison to the stations positive for euphausiids and, further, the number of the individuals found calculated as a number per $^1/_2$ hour haul: this latter for areas as an entirety and for the various water layers within the area.

**Table 5. *Thysanopoda aequalis* H. J. Hansen.**
Number per $^1/_2$ hour haul and frequency. Winter 1908—1909.

| Metres of wire | Atlantic | Cadiz Bay | Alboran Sea | Balearic Sea | Ligurian Sea | Tyrrhenian Sea | Ionian Sea | Adriatic Sea | Total |
|---|---|---|---|---|---|---|---|---|---|
| 10— 65.......... | 0 | 7 | 0 | 40 | 2 | 102 | 22 | 15 | 51 |
| 100—400.......... | 0 | 1 | 12 | 94 | 7 | 117 | 32 | 12 | 70 |
| > 500 ............ | 0.25 | 2 | 1 | 20 | 2 | 24 | 86 | 31 | 27 |
| Total... | 0.25 | 3 | 7 | 51 | 4 | 90 | 48 | 20 | 51 |
| Frequency ........ | 1/9 | 4/7 | 2/8 | 7/7 | 3/3 | 12/13 | 5/6 | 2/2 | 36/56 |

Summer 1910.

| Metres of wire | Atlantic | Cadiz Bay | Alboran Sea | Balearic Sea | Cata-Ionian Sea | Ligurian Sea | Tyrrhenian Sea | Ionian Sea | Sidra Sea | Levant | Aegean Sea | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10— 65.......... | 0 | 50 | 0 | 179 | 16 | 13 | 239 | 296 | 62 | 141 | 14 | 160 |
| 100—400.......... | 0 | 29 | 0 | 27 | 2 | 6 | 172 | 152 | 28 | 70 | 24 | 74 |
| ≥ 500 ............ | 1 | 29 | 0 | 26 | 10 | 3 | 74 | 64 | 8 | 48 | 3 | 42 |
| Total... | 1 | 38 | 0 | 92 | 9 | 8 | 173 | 153 | 42 | 75 | 12 | 99 |
| Frequency ........ | 1/17 | 5/8 | 0/10 | 16/20 | 3/4 | 3/4 | 13/13 | 7/8 | 3/8 | 2/4 | 3/6 | 56/99 |

As the table shows *T. aequalis* has been taken with greater frequency and in greater numbers in the central parts of the Mediterranean than in the Atlantic Ocean and Cadiz Bay. It is rare and occurs only in small number in the Alboran Sea in the winter of 1908—1909 and is altogether lacking at the 10 stations taken there during the summer of 1910. This circumstance shows that the stock in the Mediterranean is independent, without connection through the Straits of Gibraltar with the stock outside. The species is very common and occurs in the greatest numbers in the Balearic, Tyrrhenian and Ionian Seas. On an average the species was taken in double as great quantities in 1910 as in 1908—1909, a proportion which must be ascribed to a great quantity of young individuals. In the material from the summer of 1910 there are frequently two groups of sizes among the individuals, especially from the Ionian Sea. LEBOUR (1926 II) has described the larvæ of this species from material taken off Alexandria during the period February May. Our material confirms that the main spawning takes place during the spring and summer, and the open sea in the Balearic, Tyrrhenian and Ionian seas seems to be the centre for its distribution.

This material from open young fish trawls which were chiefly used at night can, naturally, only with great reservation be used to judge the vertical distribution of the euphausiids, but the results, however, bear out that *T. aequalis* must belong to the surface layer above 150—200 metres. In the 1908—1909 material the greatest number was taken in hauls with 100—400 metres in the majority of areas and as an average, and in all 82 % of the individuals was taken in these and shallower hauls. The greatest number was taken in the summer of 1910 in hauls with 10—65 metres of wire, and 95 % in hauls with less than 400 metres of wire.

According to J. N. Nielsen (1912) the surface layer in the Mediterranean has, on the average, an extent of 150—200 metres. In this water layer *T. aequalis* can be spread from the central areas in the Balearic-Tyrrhenian-Ionian Seas over the greater part of the Mediterranean, but hardly westwards to the Alboran Sea and out through the Straits of Gibraltar. This explains why the species is not taken in the Alboran Sea during the summer. During the winter, on the other hand, when the species is taken in a greater degree in deeper hauls and when the inward movement of the surface layer water is weaker some transport with the intermediate layer outwards into the Alboran Sea is more likely. This is also borne out by the fact that in the Alboran Sea *T. aequalis* is only taken with 300 metres or more of wire. It is no doubt possible that, in any event, larvæ or young animals from Cadiz Bay can be carried into the Mediterranean during the summer with the strongly inward flowing surface water, the more so as this is undoubtedly the case with other species, but no find is available which can betoken this. Investigations in these waters in the spring would possibly yield material to decide this question.

*T. aequalis* is the only species of this genus taken in the Mediterranean.

### 4. **Thysanopoda acutifrons** Holt & Tattersall.

Hitherto *Thysanopoda acutifrons* has only been taken in the North Atlantic Ocean where it has been captured west of the Faroes, south and west of Iceland (to 65°20′ N. Lat.) and in Davis Strait. On the "Michael Sars" Expedition of 1924 it was taken in Davis Strait as far north as 66°58′ N. Lat., 59°10′ W. Long. (Station 43, vert. haul 500—300 metres, 1 specimen, vert. haul, 300—0 metres, 1 specimen. Temperature maximum in 400 metres, 1°20). Further, it has been taken in small numbers in the south-easterly corner of the Gulf of Maine (Bigelow 1926). In the north-west Atlantic it has been captured southwards to 37°12′ N. Lat., 69°30′ W. Long. and on the eastern side in the Bay of Biscay down to 46°15′ N. Lat. (Hansen, 1915).

In the present material it was taken at one station in 1905 and 5 stations in 1906, in small numbers outside the isobath for 1000 metres south-west and south of Ireland. Further, it was taken in Cadiz Bay at 3 stations in 1908—1909 and at 3 stations in 1910. The southern limit in the eastern Atlantic Ocean has thus been pushed southwards to 35°53′ N. Lat., 7°26′ W. Long. (station 65, 1909). 2 individuals were taken in hauls with 300 metres of wire (station 234, 1910) and the remainder, 206 in all, were taken in hauls with more than 800 metres down to 3000 metres of wire. The finds, in other words, confirm that the species is distinctly a deep-water form which has its commonest distribution deeper than 400 metres.

### 5. **Thysanopoda microphthalma** G. O. Sars.

*Thysanopoda microphthalma* was taken by the "Challenger" in the North Atlantic at 26°21′ N. Lat., 33°37′ W. Long. Hansen (1905) has several specimens from the area Banc de Goringe—Azores—Canary Islands. Further, it is known from the west coast of Ireland. Tattersall (1926) has it from several localities between the Bermudas—Florida Straits. In our material one individual is determined to this species, taken at station 234, Bay of Setubal, 10/9/1910, 1000 metres of wire.

### 6. **Thysanopoda pectinata** Ortmann.

*Thysanopoda pectinata* has been taken in tropical and sub-tropical waters in all three oceans. In the Prince of Monaco's material it was taken in the sea to the west of south Spain, Ortmann obtained it in the northern equatorial current in the Atlantic Ocean and Illig found young individuals (described by him as *Parathysanopoda foliifera*) in the Benguela Current. It has been taken in the Indian Ocean and in the East Pacific between 24° and 6° S. Lat. (Hansen 1912 and 1915).

In our material 3 individuals were captured at station 231 in Cadiz Bay on 8/9/1910. These were found isolated in a tube which was insufficiently labelled so that the depth at which they were taken is unknown.

### 7. Meganyctiphanes norvegica M. Sars.

*Meganyctiphanes norvegica* has an Atlantic boreal distribution. It was found far in the Polar Sea (to 81° N. Lat. 124° E. Long.) by the "Fram" Expedition and it has been taken at 74°30′ N. Lat. near the east coast of Greenland (Kramp, 1913). In Davis Strait the "Michael Sars" Expedition of 1924 took it as far north as 66°30′ N. Lat., 54°15′ W. Long. Previously it had only been reported in these waters north to 60°7′ N. Lat. by Hansen (1915). On the east coast of America *M. norvegica* is stationary in the Gulf of Maine (42°—45° N. Lat.) and is rare west of Cape Cod (Bigelow, 1926). Tattersall, however, has it in material taken as far to the south-west as 36°12′ N. Lat.—74°41′ W. Long., almost down to Cape Hatteras (Tattersall, 1926). Between Cape Cod and Cape Hatteras, therefore, it is to be found occasionally. Further, it is known from the Gulf of St. Lawrence, but not from the arctic water masses along the coast of Newfoundland and Labrador. Along the west coast of Europe *M. norvegica* is found from the Murman Coast, commonly off the coast of Norway to the Oslo fjord, and further in the Skagerak and Cattegat (Kramp, 1913, Hjort and Ruud, 1929). It is known off the coasts of the British Isles, in the Bay of Biscay and off the coasts of Spain and Portugal to Cadiz Bay. Hitherto it does not seem to have been taken south of about 35° N. Lat. in Cadiz Bay.

Many authors have previously indicated *M. norvegica* in the Mediterranean as from the western part, and on the basis of the same material as that with which we are dealing, Jespersen (1923) has shown that it is found in the Adriatic, Bay of Tarent, and the northern part of the Ionian Sea, the Ægean Sea and the Sea of Marmara.

In the Gulf of Maine, where Bigelow (loc. cit.) is of opinion that *M. norvegica* has its most southerly important centre of abundance on the east coast of America it has been taken in temperatures from 2°—3° up to 19°5, but he considers that its permanent existence and reproduction is conditional upon a temperature range of 3°—15°. In the Skagerak *M. norvegica* has occasionally been taken in the surface layer at a temperature down to ÷ 0°38, but its regular habitation is in water of a temperature between 3° and 7°. In the Skagerak *M. norvegica* follows the Atlantic water masses just as it follows the branchings of the Irminger current round Iceland into Denmark Strait and Davis Strait. From the Norwegian Sea it also follows the Atlantic Ocean water further right into the Polar Sea. In the Gulf of Maine *M. norvegica*, however, is strictly limited to the boreal water masses which from Newfoundland to Cape Hatteras wedge themselves in between the coast and the warm Atlantic water masses outside.

According to G. Schott (1912) the isotherm for 15° at a depth of 100 metres in the Atlantic Ocean follows a course which coincides well with the well-known southern distribution of *M. norvegica*. The isotherm proceeds from Cape Hatteras in the west towards the north-east to about 40° N. Lat. south of Nova Scotia, follows approximately the 40th latitude to the Azores and proceeds thence to Cadiz Bay. In the Mediterranean *M. norvegica* is also found in the areas where the temperature at a depth from 50—100 metres is always below 15° C. To a great extent *M. norvegica* is taken in higher water layers where the temperature is more than 15°, right up to 17° or more, but the samples are from night hauls and we must therefore take into account that the animals may have migrated up from deeper water layers where the temperature is below 15°.

In the Levant an individual was taken at station 160, directly south of Rhodes on 1/8/1910, but in a haul with a 1000 metres of wire. In shallower hauls the species was not taken. At this station the temperature deeper than 100 metres was also lower than 15°.

In the Ionian Sea and the Gulf of Corinth *M. norvegica* was fished in small numbers at three stations in the northern part (stations 184, 186 and 187) during the summer of 1910. Here temperatures were high in the upper water layers, but at a greater depth than 75—100 metres the temperature is below 15°, and the individuals were taken in hauls with 300—1000 metres of wire and not in upper hauls. In Jespersen's chart of the distribution of *M. norvegica* in the Mediterranean (loc. cit. Fig. 8) a find is marked at station 179 at the mouth of the Dardanelles. This is not among the material which has been sent to me. In Fig. 7 on the chart appear the finds of *M. norvegica* in our material. A number of the 1905, 1906 and 1911 finds lie outside the framework of the chart in the north and west. For these see table I in the Appendices.

*M. norvegica* in the 1905 and 1906 materials was taken along the Atlantic slope from the innermost part of the Bay of Biscay to west of Ireland. The 1911 Atlantic captures were made as far towards the north-west as 42°37′ N. Lat., 18°6′ W. Long. at station 267; 47 metres of wire, 2 individuals.

The text table below gives a resumé of the occurrence of *M. norvegica* in the material of 1908—1909 and 1910. As in the case of *T. aequalis* I have calculated the number per half-hour haul for the various water layers within the different areas and in addition the frequency in proportion to all stations positive for euphausiids.

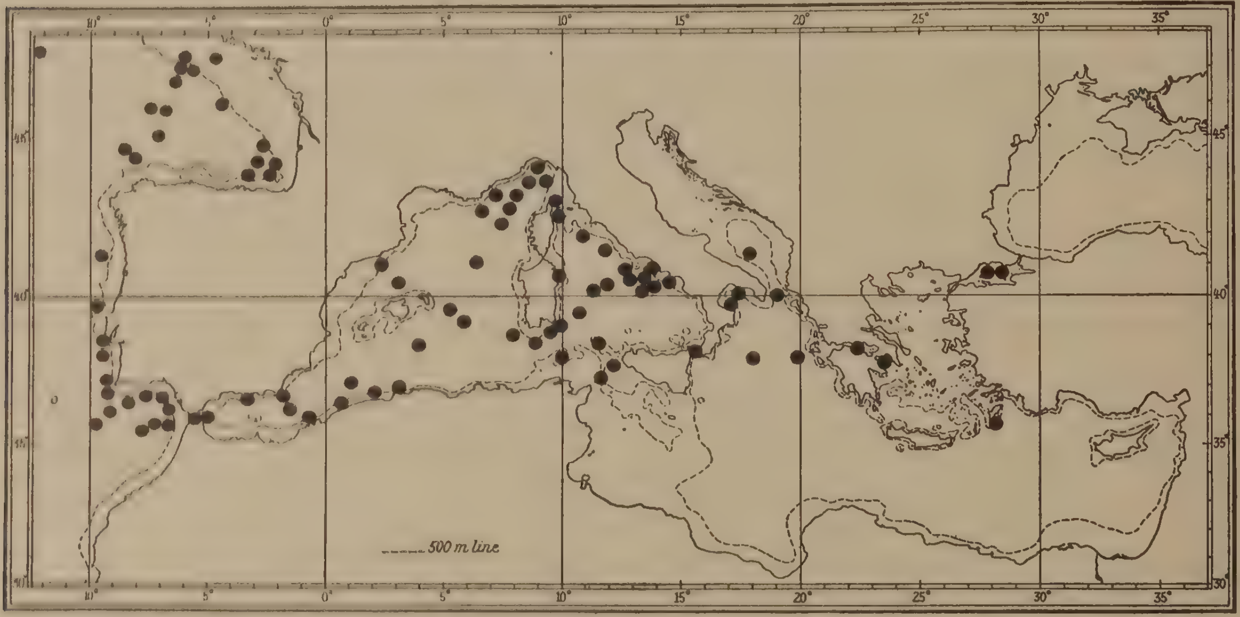

Fig. 7. *Meganyctiphanes norvegica.* Positive stations 1906, 1908—09, 1910, 1911.

The frequency within the different areas shows that *M. norvegica* is common in the Bay of Biscay, the Atlantic and Cadiz Bay, both in winter (1908—1909) and summer (1910). During the winter it was not taken in the Ionian Sea outside the Bay of Tarent, and it was rare in the Alboran Sea and the Balearic Sea, but common in the other areas investigated. (In the Ægean Sea only one station was taken). In the summer material it is rare from the Alboran Sea, Catalonian Sea, Ionian Sea, and the Levant, and it is absent from the Sidra Sea and Ægean Sea. The Adriatic Sea was not examined on this expedition. Very large catches were taken, both winter and summer, in the Bay of Biscay, the Atlantic and Cadiz Bay. The greatest catches in the Mediterranean were made in the Ligurian Sea, the Bay of Tarent and the Adriatic Sea during the winter and in the Ligurian Sea, the central part of the Balearic Sea and the northern part of the Tyrrhenian Sea during the summer.

Jespersen (loc. cit. page 14) states that *M. norvegica* was taken in great numbers by the "Dana" in the Straits of Gibraltar in October 1921 and from this he draws the conclusion that in definite seasons or in particular years the species may be common in the Alboran Sea. I assume that in such an event *M. norvegica* is transported with the surface water from Cadiz Bay where, to judge by our material, it must be common.

In the Mediterranean *M. norvegica* must be stationary in the northern areas, in the Ligurian Sea with the northerly part of the Balearic and the Tyrrhenian Sea, in the Adriatic with the Bay of Tarent and the northerly part of the Ionian Sea, and in the Sea of Marmara. From these places the species can be spread with the surface water over great parts of the Mediterranean Sea.

Table 6. ***Meganyctiphanes norvegica*** **M. Sars.**
Number per 1/2 hour haul and frequency. Winter 1908—1909.

| Metres of wire | Atlantic | Cadiz Bay | Alboran Sea | Balearic Sea | Ligurian Sea | Tyrrhenian Sea | Bay of Tarent | Adriatic Sea | Aegean Sea | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 10—65 | 78 | 410 | 1 | 1 | 89 | 20 | 609 | 68 | 0 | 128 |
| 100—400 | 258 | 61 | 0 | 2 | 11 | 6 | 2 | 1 | 0.5 | 43 |
| > 500 | 25 | 69 | 1 | 0 | 0 | 3 | 4 | 3 | 0 | 28 |
| Total | 87 | 201 | 1 | 1 | 46 | 12 | 245 | 36 | 0.5 | 78 |
| Frequency | 4/9 | 5/7 | 2/8 | 3/7 | 3/3 | 11/13 | 2/2 | 2/2 | 1/1 | 33/56 |

Summer 1910.

| Metres of wire | Atlantic | Cadiz Bay | Alboran Sea | Balearic Sea | Catalonian Sea | Ligurian Sea | Tyrrhenian Sea | Ionian Sea | Levant | Marmara Sea | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10—65 | 8415 | 140 | 2 | 81 | 0 | 959 | 57 | 0 | 0 | 9 | 2647 |
| 100—400 | 1248 | 30 | 3 | 83 | 0 | 119 | 22 | 4 | 0 | 7 | 308 |
| > 500 | 111 | 1156 | 1 | 9 | 4 | 81 | 4 | 2 | 0.5 | 0 | 259 |
| Total | 3831 | 506 | 2 | 68 | 4 | 533 | 20 | 2 | 0.5 | 8 | 1035 |
| Frequency | 10/17 | 5/8 | 4/10 | 12/20 | 2/4 | 4/4 | 6/13 | 3/8 | 1/4 | 2/2 | 49/99 |

To the extent to which tow hauls are capable of providing information on the point, the table also shows the vertical distribution of *M. norvegica*. In both the winter and summer material the greatest numbers were taken near the surface in the majority of areas, in hauls with 10 to 65 metres of wire during the night. During the winter 1908—1909 the greatest number in the Bay of Biscay-Atlantic was taken in hauls with 100 to 400 metres of wire, and in the summer of 1910 the largest quantity was taken in Cadiz Bay in hauls with 1000 metres of wire. Otherwise there is a distinct tendency for *M. norvegica* to be taken near the surface in the areas where it is most common, the Ligurian Sea, the Adriatic Sea and the Bay of Tarent, whereas it has a relatively deeper distribution in the areas in which it is more rare. The numbers per half hour haul are, in the case of the majority of areas, many times greater in the summer material than in the winter material. To some extent this may be due to fortuitous circumstances, such as the positions of the stations, e. g. in the Balearic Sea and Ionian Sea, but otherwise it is certainly attributable to a considerable increase in the stock by the influx of a new generation spawned in the winter and spring.

### Growth and reproduction of *M. norvegica*.

Dr. Vilh. Ege has measured the length of *M. norvegica* in the majority of samples in the 1908—1909 and 1910 material and I owe him a debt of gratitude for his permission to make use of his material. He measured the distance from the centre of the eye to the hind margin of the sixth abdominal joint. These measurements proceed from Table II in the Appendices, in which some few samples have been measured by me in the same manner as Ege has employed. If the measurement obtained in this manner is multiplied by 1.2, the total length of the animal from the point of the rostrum to the tip of the telson is found.

From a number of the measurements from the summer material it immediately proceeds that there are two groups of sizes in the sample. In other samples I have been able to divide the material into two groups inasmuch as I have, simultaneously, found support in my investigations into the degree of maturity of the sexual organs. I can thus separate a mature group from an immature group.

In investigating the degree of maturity I have employed the same method of procedure as I have previously described (Ruud, 1932), where, according to a subjective estimate, I have divided the ovaries and the spermatophore conditions of the males into 4 stages. It has proved that all individuals of less than 16—18 mm. are quite immature. But also in samples in which there are two size groups of large animals, e. g. at stations 34, 35 and 36 on the 23rd, 28th and 30th January 1909, there is a difference in degree of maturity between the largest and the smallest animals. The largest are quite mature and fertilised, individual females also spent, whereas the smaller animals are virginal with smaller ovaries and the males without visible spermatophores.

Naturally, all measured animals have not been examined in this detailed manner. I have been obliged to limit myself to taking random samples of the various sizes, but I have, nevertheless, found it justifiable to use the indication which such random samples give to split up the whole of the measured material into two groups where this is of significance.

From the measurements in Table II the average length for each group of sizes has been calculated, and these average lengths are set out in Fig. 8. In this Figure I have combined the measurements from 1908—1909 with those from 1910 as if the materials were derived from the winter and summer of the same year. By such combination errors will naturally creep in if there are great annual fluctuations in the time of maturing and spawning. But as such fluctuations, if they occur, will probably be simultaneous in the areas here in question, any error which arises will be of little consequence for our conclusions.

In the figure I have, therefore, attempted to construct the growth curve for *M. norvegica* in the three areas in which the material seems sufficient, namely, the Bay of Biscay, Cadiz Bay and the northerly Balearic-Ligurian Sea. The investigation into the degree of maturity shows that *M. norvegica* from these waters is quite mature in the winter material and spawning must take place during the period new year and onwards to the end of April. In this connection I would call to mind that on the west coast of Norway *M. norvegica* spawns mainly from April to June.

The spawning probably begins in Cadiz Bay, taking place subsequently, probably February-March, in the Bay of Biscay and in the Balearic-Ligurian Sea probably onwards to April. It must be borne in mind that the latest specimens of large *M. norvegica* from the Mediterranean during the winter were taken on the 31st January. Nothing can, therefore, be concluded with certainty regarding the time of spawning and its duration.

In the 1910 summer material, which in the case of the Mediterranean pertains to the last days in June and onwards to the end of August, the large females are partly spent and in part the ovaries are in regeneration. That spawning in the Mediterranean takes place in the spring is confirmed by Lo Bianco (1909) who found females with mature eggs in the ovary in the month of March.

We have little material to enable us to determine the growth of the young larvae as observations for the period March-June are lacking. Moreover, the smallest larvæ go through the meshes in the stramin which is used for the young fish trawl. The smallest individuals found were 4 in Cadiz Bay, dating from the end of February, 7—8 mm. in size, and 2 from the Alboran Sea, 8 and 9 mm. long. These latter must either originate from Cadiz Bay, or if spawning in the Alboran Sea does take place, then it coincides with the spawning outside Gibraltar. Combined with the smallest group of *M. norvegica* from the same area in June these finds will justify us in drawing a curve for the growth in Cadiz Bay such as that made in the figure. With this for comparison we can also indicate the progress of the curve in the other areas.

Within the smallest group from the summer material there are great variations in the average lengths of the animals, and this suggests that there is a long spawning period. The deviations from the curve drawn, however, are due to the material from the Tyrrhenian Sea, where the spawning, if any does occur, probably takes place earlier than in the Ligurian Sea.

If we trace the growth curve for Cadiz Bay we find that it proceeds in the following manner. Spawning takes place during the period following the new year. The young grow from about 8 mm. at the end of February to 16—18 mm. in the middle of June, and, more gradually, to about 19 mm. by the beginning of September. During the autumn and winter there is little growth. At the beginning of December the individuals of this group are 20—21 mm., but reach 23—24 mm. at the end of February. Examinations of the sexual organs of animals of this group, we can call them first time spawners, indicate that they spawn from the end of February till well into March. In such an event the spawning time in Cadiz Bay must extend over 2—3 months which, per se, is not astonishing. In the summer material from Cadiz Bay the largest individuals have attained to an average length of 25 mm., and, according to this course of growth which has been sketched out, they should be about eighteen months old. The sexual organs are in course of regeneration. Many objections can be raised to this presentation of the life-cycle of *M. norvegica*, including that, that as a whole, it hardly proceeds so schematically. There are undoubtedly many possibilities of interchange with areas in which the time of spawning and conditions for growth are otherwise. It seems justifiable, however, to establish that *M. norvegica* in these waters spawns early in the year, that it becomes mature at the age of one year, but continues to grow somewhat in its second year.

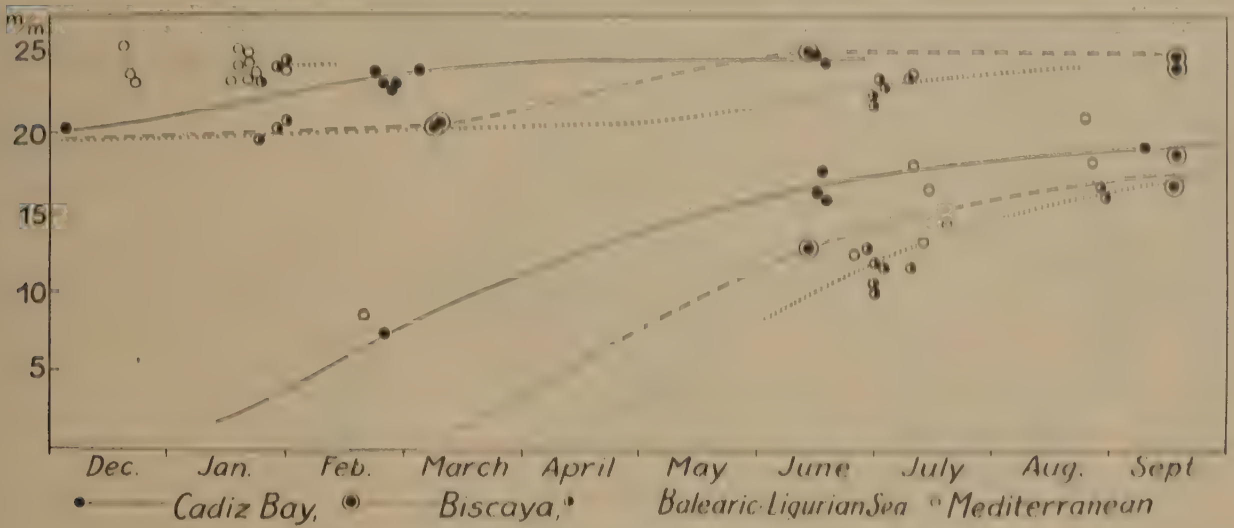

Fig. 8. Mean lengths and growth curves for *M. norvegica* in different waters.

In conformity with the growth curve for Cadiz Bay a curve can also be drawn for the Bay of Biscay and for the Balearic-Ligurian Sea; and in the same manner as the spawning time and the growth of the young animal is displaced to a later period of the spring so also is the growth period in the second year similarly displaced.

Jespersen has already (loc. cit.) dealt with the significance of *M. norvegica* for the quantity of macroplankton in the Mediterranean, and has pointed out that particularly in the northern parts it must play an important part. It is also a well-known fact that *M. norvegica* is of some importance as food for tunny fish (Joubin & Roule, 1918) and in our material there are also two samples of stomach contents of tunny fish caught off Faro (Messina 3/3/1911) both of which consisted wholly and solely of large, mature *M. norvegica*.

From 1923 to 1926 whaling was carried on from a shore station at Getares near Algeciras in the Straits of Gibraltar. The whales mainly taken were finbacks (*Balaenoptera physalus*) which migrated into the Mediterranean during the first months of the year. In the Mediterranean they gave birth to their young and paired anew, so that when, later in the year, they withdrew from the Mediterranean they were accompanied by fairly large young. I have endeavoured to ascertain what the contents of the stomachs of these finbacks con [illegible] but at that time no observations were made in this respect and no definite statement can therefore be made. It is, however, all but an obvious conclusion that the reason for the appearance of the finback in the Mediterranean at this period of the year is in part because feeding conditions must be good. From our previous investigations (Hjort & Ruud 1929) we know that the finback resorts to the banks off the west coast of Norway at the time the "krill", *Thysanoessa inermis* and *M. norvegica*, spawn and therefore have an even greater tendency to shoaling than otherwise.

The migration of the finbacks into the Mediterranean also coincides with the spawning of the "krill", in this case *M. norvegica*.

### 8. Nyctiphanes couchii Bell.

*Nyctiphanes couchii* is only known from the north easterly part of the Atlantic Ocean and the Mediterranean Sea, and is a characteristic slope form. Its most important area of distribution is the Channel and the shelf south west of Ireland. Here, together with *M. norvegica*, it is the commonest euphausiid in the plankton (Fraser, 1929). According to Kramp (1913) *N. couchii* occurs otherwise in the southern part of the North Sea, in the Irish Sea and possibly off the west coast of Scotland. According to H. J. Hansen (1911) *N. latifrons* (Illig) are young individuals of *N. couchii* (8 mm.) and they were taken as far south as Cape Blanco (21° N. Lat.) on the west coast of Africa. Hansen had himself material of *N. couchii* from the Atlantic coast of Morocco. In the western Mediterranean *N. couchii* has been found in material from the "Maia" and "Puritan" Expeditions, but Tattersall (1909) draws the conclusion that the species apparently is not common in the Mediterranean. It is not reported from Messina in any of the many papers by Colosi and others.

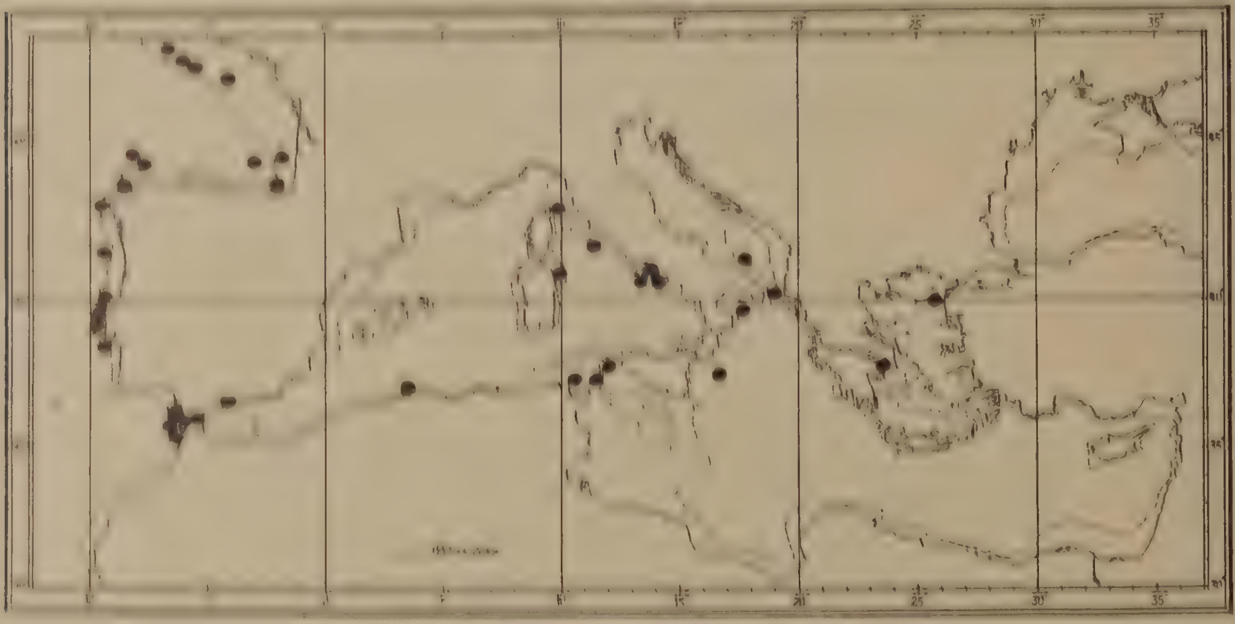

Fig. 9. *Nyctiphanes couchii*. Positive stations 1906, 1908–09, 1910.

The northern limit for *N. couchii* has apparently moved northwards since Kramp's material was collected. According to investigations undertaken by Nyberg (Hjort & Ruud 1929) *N. couchii* is not rare in the Skagerak, and it is stationary and spawns there. Occasionally we have found individuals as far north along the Norwegian coast as Møre, about 63° N. Lat.

In the present material *N. couchii* was taken, to some extent in considerable quantities, south west of Ireland and inside in the Bay of Biscay in 1906, in all at 8 stations, all situated on the continental shelf and slope. The chart, Fig. 9, gives the finds of *N. couchii* in the material from 1908—1909 and 1910 as well as the three stations innermost in the Bay of Biscay 1906. *N. couchii* is the only euphausiid which was taken at the stations in the Channel in these years. This is not revealed by the chart. Otherwise it has been taken at many places along the Atlantic coasts of Spain and Portugal, in the Straits of Gibraltar and at a station in the Alboran Sea. In the Mediterranean it has, furthermore, been taken in the southern Balearic and in the Tyrrhenian Seas, in the northern part of the Ionian and Adriatic Seas and in the Aegean Sea. Everywhere it has been taken in shallow water or close to the coast. It has not been taken in the northern Balearic, the Ligurian and the Catalonian Seas, nor was it found by DENIS (1929) off Banyuls-sur-Mer.

The number per half-hour haul and the frequency proceed from the accompanying table.

**Table 7.** ***Nyctiphanes couchii*** **Bell.**

Number per ½ hour haul and frequency. Winter 1908—1909

| Metres of wire | Channel | Atlantic | Cadiz Bay | Alboran Sea | Balearic Sea | Tyrrhenian Sea | Bay of Tarent | Adriatic Sea | Aegean Sea | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 10— 65 | 64 | 72 | 444 | 0 | 1 | 2 | 0.5 | 4 | 6 | 70 |
| 100—400 | 0 | 5 | 147 | 8 | 0 | 0.5 | 1 | 1 | 0 | 10 |
| ≧ 500 | 0 | 1 | 1 | 2 | 0 | 0 | 0.5 | 0 | 0 | 1 |
| Total... | 64 | 25 | 260 | 5 | 1 | 1 | 0.5 | 2 | 6 | 33 |
| Frequency | 2/2 | 5/7 | 2/7 | 2/8 | 1/7 | 6/13 | 2/2 | 2/2 | 1/1 | 24/50 |

Summer 1910.

| Metres of wire | Channel | Atlantic | Cadiz Bay | Balearic Sea | Aegean Sea | Total |
|---|---|---|---|---|---|---|
| 10— 65 | 185 | 6160 | 5 | 34 | 1 | 2409 |
| 100—400 | 0 | 191 | 27 | 14 | 0 | 129 |
| ≧ 500 | 0 | 5 | 0 | 1 | 0 | 4 |
| Total... | 185 | 3486 | 11 | 22 | 1 | 1593 |
| Frequency | 2/2 | 8/15 | 3/8 | 3/20 | 1/8 | 17/99 |

It is striking how much richer the Atlantic catches are than the Mediterranean. The largest catches during the winter were made in Cadiz Bay and during the summer off the coast of Portugal. Here, at station 236, near to 40° N. Lat. there were caught, on 13/9/1910, 29,800 individuals (juniores) in a half hour haul with 25 metres of wire. The largest catch in the Mediterranean was made at station 139, near to the western end of Sicily in the Pantellaria Channel on 20/7/1910, consisting of 58 individuals in a half hour haul with 25 metres of wire.

It seems remarkable that in the summer of 1910 *N. couchii* was not taken in the Tyrrhenian Sea where it was captured in small numbers during the winter of 1908—1909 at 6 out of 13 stations. This, however, is understandable when we bear in mind that the shallow coastal waters were left practically uninvestigated during the summer expedition.

Our finds suggest that *N. couchii*, in spite of the small numbers by which it is represented, must be stationary in certain parts of the Mediterranean, namely in the Tyrrhenian, Adriatic and Aegean Seas. In Cadiz Bay the species occurs both more frequently and in greater numbers than in the Mediterranean and we must undoubtedly take into consideration that there is some supply of *N. couchii* with the surface water through the Straits of Gibraltar into the Alboran Sea. If this invasion track were of major importance, we might, however, to have been able to count upon several finds along the Algerian coast, where many stations were taken up both in summer and winter. Only one individual was found, however, namely, at Station 47 near the town of Algiers on 10/9/1908, 65 metres of wire, 1/2 hour haul. The remainder of the finds in the Balearic Sea were made far away in the Pantellaria Channel.

Lo Bianco (1909) has found ovigerous females in the coastal current in the Tyrrhenian Sea during the period February-May. He states that the larvae of *N. couchii* are very common in these waters (near Naples) in the surface layer, and in "Knephoplankton" from March to June. South-west of Ireland, and in the Channel in the vicinity of Plymouth, spawning takes place particularly in April-May-June, but young larvae can be found as a sign that spawning has taken place practically the whole year round (Lebour, 1924, Frost, 1933).

More than any other euphausiid *N. couchii* is identified with the shallow coastal waters where to an essential degree it feeds on detritus, even if during the night it regularly migrates towards the surface and subsists on diatoms. From Spärck's investigations (1931) we know that the bottom fauna of the Mediterranean is substantially poorer than that of the Atlantic, and he mentions that it must be the food conditions which are the determining factor in this case. It is reasonable to assume that this circumstance is of some consequence to *N. couchii* and that this, therefore, explains the rare and scanty occurrence of the species in the Mediterranean.

## 9. Euphausia krohnii Brandt

Before H. J. Hansen described *Euphausia americana* in 1911 it was assumed that *Euphausia krohnii* was distributed throughout the whole of the Atlantic Ocean from the Cape of Good Hope to the west coast of Norway, but in literature subsequent to the date in question *E. krohnii* is not found with certainty south of about 30° N. Lat. It must therefore be regarded as a North Atlantic species with a general distribution from about 30° and northwards. On the east coast of America it has been taken up to about 43° N. Lat. (Hansen, 1915) and on the European coast north to about 68° N. Lat. off the west coast of Norway (Ruud, 1928). In the Irminger Current some specimens were taken by the "Michael Sars" expedition of 1924 at 59°48' N. Lat. 31°45' W. Long. (Hjort & Ruud 1929). Its most common occurrence along the coast of Europe is confined to the waters of Cadiz Bay past the mouth of the Channel to off the west coast of Ireland at about 51° or 53° N. Lat. (H. J. Hansen, 1915). In the Mediterranean it was previously known only from the western part until Lebour (1930). He described the larvae from the eastern Mediterranean off Alexandria.

In our material from 1908 it was taken north to station 89, 51° N. Lat. and in 1909 to station 80, 51°34' N. Lat. At the Atlantic stations in 1911 it was taken as far south as station 370, 34°41' N. Lat., 16°14' W. Long. The distribution in the Atlantic and Mediterranean as found in our material is shown on the chart Fig. 10. In the Mediterranean it has been taken in all areas investigated.

From his examination of material from the waters Chesapeake Bay–Bermudas–Florida Straits Tattersall (1936) arrived at the result that *E. krohnii* must be regarded as a boreal species, representing a northerly element in the plankton, whereas Bigelow (1926) suggests that it must be considered as "a straggler from the warmer Atlantic". On the west coast of Norway and south of Ireland it must also be considered as an Atlantic representative.

The fact is, *E. krohnii* is an oceanic species with a comparatively narrow range of tolerance in regard to temperature. If we look at Schott's chart of the temperature at a depth of 100 metres (Schott 1912), it seems as if the general distribution of *E. krohnii* falls between the isotherms for 16–17° and 9° or 10°. A distribution within these isotherms also explains the limited distribution on the east coast of America, chiefly from Cape Hatteras to Cape Cod.

If we accept this temperature range for the distribution of *E. krohnii* it will also be realised that the species can be found over the whole of the Mediterranean. Even if the temperature in the upper water layers rises considerably above 17° during the summer in the eastern and southern Mediterranean, the upper layers of the intermediate water will offer suitable temperature conditions.

Taking this view as our starting point we will look more closely at the distribution in the Mediterranean on the basis of the material from 1908—1909 and 1910. In the table on page 30 the number per half hour haul is calculated as usual for the various areas and for the usual depths. In other respects I would refer to the table at the end of this paper and to the chart, Fig. 10.

*Euphausia krohnii* is the most commonly occurring euphausiid in the Mediterranean. In the 1908—1909 winter material it was taken at all stations investigated in the Mediterranean and in Cadiz Bay. In the summer material, however, it was missing at several stations, as it was only in the Alboran, Catalonian and Marmara Seas that it was taken at all stations. It was taken at 14 out of 20 stations in the Balearic Sea, at 11 out of 13 in the Tyrrhenian and at 7 out of 8 in the Ionian Sea. In the Levant it was only taken at 1 station out of 4. The other finds in the Levant date from 1911 and 1912.

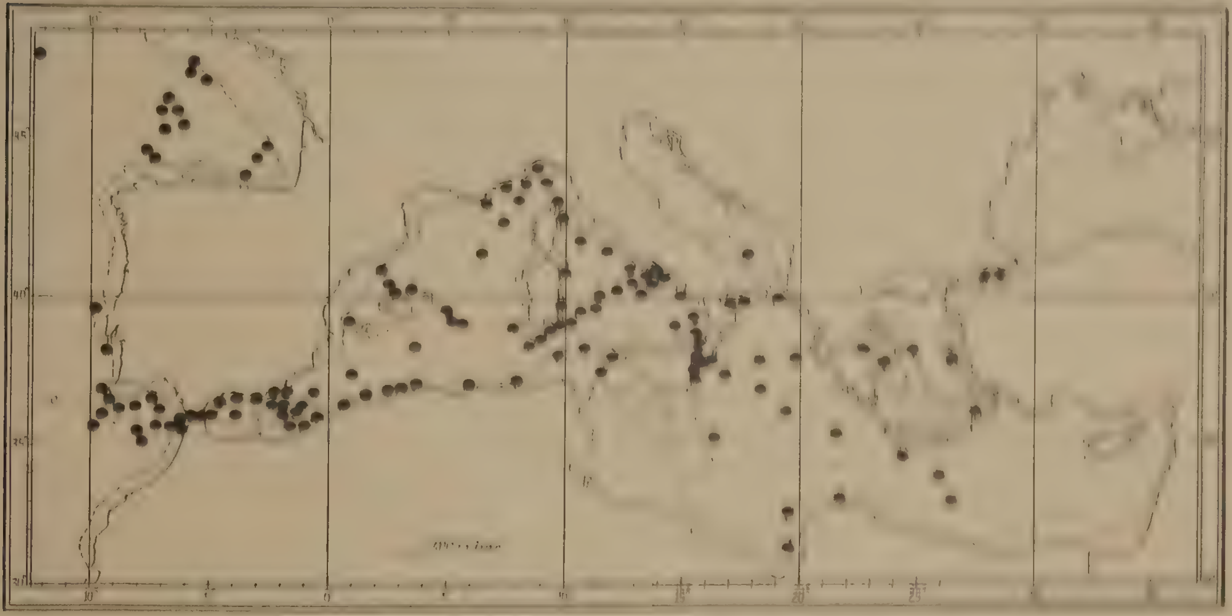

Fig. 10. *Euphausia krohnii.* Positive stations 1906, 1908—09, 1910, 1911, 1912.

From the number per half-hour haul it will be seen in the first place that considerably greater numbers were taken in all areas in the summer than in the winter, a circumstance which must undoubtedly be ascribed to the supply of a new generation from the spring spawning. For the whole of the material the average is 76 per $^1/_2$ hour in 1908—1909 and 275 per $^1/_2$ hour in 1910.

The richest catches in the Mediterranean were made in the Alboran, Tyrrhenian and Balearic Seas in both summer and winter. During the winter, moreover, rich catches were made in the Adriatic Sea and during the summer in the Aegean Sea. Outside the Mediterranean Sea, in Cadiz Bay and in the Atlantic Ocean the catches are considerably less. In the Mediterranean the species is only taken in small numbers in the Sidra Sea and in the Levant in the summer and in the Ligurian Sea in the winter. I must here take the reservation that *E. krohnii* seems to have a greater tendency to shoaling than many of the other small euphausiids. As an example I would point to stations 104 and 106, taken close to each other in the Alboran Sea on the 24th and 25th June 1910. In hauls of half an hour's duration with 65 metres of wire during the night 1 and 75 individuals respectively were taken. Station 104, however, was not investigated at greater depth at which, at station 106, there was a large stock. Nor were the hydrographical conditions at station 104 examined so

**Table 8. *Euphausia krohnii* Brandt.**

Number per $^{1}/_{2}$ hour haul and frequency. Winter 1908—1909.

| Metres of wire | Atlantic | Cadiz Bay | Alboran Sea | Balearic Sea | Ligurian Sea | Tyrrhenian Sea | Ionian Sea | Adriatic Sea | Aegean Sea | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 10— 65 | 12 | 14 | 295 | 307 | 8 | 68 | 14 | 203 | 45 | 80 |
| 100—400 | 23 | 4 | 162 | 111 | 8 | 119 | 6 | 60 | 6 | 85 |
| > 500 | 26 | 5 | 435 | 29 | 1 | 27 | 17 | 94 | 0 | 59 |
| Total... | 19 | 9 | 273 | 186 | 6 | 78 | 15 | 143 | 26 | 76 |
| Frequency | 5/7 | 7/7 | 8/8 | 7/7 | 3/3 | 13/13 | 6/6 | 2/2 | 1/1 | 52/56 |

Summer 1910.

| Metres of wire | Atlantic | Cadiz Bay | Alboran Sea | Balearic Sea | Catalonian Sea | Ligurian Sea | Tyrrhenian Sea | Ionian Sea | Sidra Sea | Levant | Aegean Sea | Marmara Sea | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10—65 | 87 | 150 | 399 | 905 | 227 | 228 | 150 | 127 | 0 | 1 | 365 | 172 | 379 |
| 100—400 | 13 | 27 | 611 | 469 | 0 | 52 | 232 | 39 | 2 | 10 | 482 | 96 | 279 |
| ≧ 500 | 10 | 26 | 89 | 126 | 59 | 78 | 279 | 15 | 1 | 12 | 94 | 37 | 98 |
| Total... | 46 | 84 | 427 | 624 | 131 | 144 | 211 | 64 | 1 | 9 | 304 | 100 | 275 |
| Frequency | 7/15 | 6/8 | 10/10 | 14/20 | 4/4 | 3/4 | 11/13 | 7/8 | 2/3 | 1/4 | 3/6 | 2/2 | 70/99 |

that it cannot be established whether there was any difference which could stipulate the different occurrence of *E. krohnii*. But this example shows, in any event, that the manner in which the stations are taken and the depths which are investigated have a certain significance. Nevertheless, there is sufficient reason to conclude from the figures obtained that the species *E. krohnii* has its central distribution in the western Mediterranean in the Alboran, Balearic and Tyrrhenian Seas and in the eastern Mediterranean in the Adriatic and Aegean Seas. From these areas *E. krohnii* is spread over the whole of the Mediterranean. We know nothing concerning the distribution of *E. krohnii* in the Sidra Sea and the Levant during the winter, but that it occurs in small numbers there in the summer is satisfactorily explained by the fact that the surface layer has its greatest extent with high temperatures at that time. It is more difficult to find a satisfactory explanation of the comparatively small numbers in the Catalonian and Ligurian Seas, unless the low temperatures of less than 13° in the upper 200—300 metres in these northern parts in the winter are a hindrance to the thriving and spawning of *E. krohnii*.

The stations in the Atlantic in 1911 with a more oceanic situation are, on the average, considerably richer in *E. krohnii* than the stations in Cadiz Bay and along the Atlantic coasts. Even if some interchange of this species undoubtedly takes place through the Straits of Gibraltar it can scarcely be of any special significance for the populating of the various areas. The stationary stock in the Mediterranean seems thus far independent of the Atlantic Ocean stock.

It seems to be established that *E. krohnii* has a relatively large vertical distribution, even if it can often be taken immediately in the surface layer. Lo Bianco (1909) states that larvæ at various stages are found in the "Knephoplankton" (500—30 metres) and also often in the "Phaoplankton" (30—0 metres), while the adults are very frequent in the "Skotoplanktonic" zone (under 500 metres) and above all at depths about 1000 metres. His observations are from the Tyrrhenian Sea. Fowler (1905) concluded from investigations in the Bay of Biscay that *E. krohnii* hardly lives at a greater depth than 250 fathoms.

The majority of our samples are from young fish trawl which fishes during hauling in, but we have a catch made with a ring trawl (C. 200) used with 3,500 metres of wire at station 129 in the Tyrrhenian Sea in 1910. At this station 9 *E. krohnii* were taken, and as the ring trawl is closed before hauling in these must in any case, have been taken at a greater depth than 1000—1500 metres.

Our table also gives us the vertical distribution, calculated in number per half-hour at the usual intervals. The average figures for the 1908—1909 winter material show that the distribution was fairly even in the three stages of depth, but in the different areas there was some variation. Only in Cadiz Bay, the Balearic, Adriatic and Aegean Seas was there a maximum in the upper interval (10—65 metres wire). In the Alboran Sea there was an outstanding maximum under 500 metres of wire. The average for the summer of 1910 shows, for the material as a whole, that 50 % of the number was taken in hauls with 10—65 metres of wire and there is also a maximum in this interval in the majority of areas. In the Alboran and Aegean Seas the maximum number was taken at the 100—400 metres of wire interval, whereas in the Tyrrhenian Sea there was a more even distribution, with a maximum, however, below 500 metres.

Lo Bianco's investigation in the Tyrrhenian Sea confirms the common experience that larvæ and young animals are situated higher in the sea than the adults. F. S. Russell (1928) has, in the case of *Calanus finmarchicus*, observed that the various generations react differently to light, the summer generations keeping nearer to the surface than the generations which have wintered. These various circumstances explain why *E. krohnii* is to be found higher in the sea in the summer than in the winter. For the sake of orientation I have measured *E. krohnii* from various depths at individual stations showing that the animals are slightly smaller in the upper hauls than in the lower, although the difference is not great. In each case about 100 were measured, and the average length is calculated in mm.

| | 25 metres of wire | 65 metres of wire | 300 metres of wire | 1000 metres of wire | 2000 metres of wire |
|---|---|---|---|---|---|
| St. 115 29/6/1910 | 11,52 | 11,81 | 13,31 | .. | 13,25 |
| St. 204 27/8/1910 | 12,61 | 12,68 | 13,41 | 13,10 | |

The difference in size would perhaps have been greater if we had had day hauls for observation. In night hauls, of which this material is composed, the animals are naturally in the upper position of their vertical migration and many of the largest also are to be found in the upper water layers.

It is characteristic of the Tyrrhenian Sea that *E. krohnii* is situated deeper than in most of the other areas. This agrees with the vertical distribution dealt with by Lo Bianco, and the explanation is possibly to be found in the fact that the intermediate water layer is thicker in the Tyrrhenian Sea than in any other area (Nielsen 1912).

*E. krohnii* spawns in the spring and onward throughout the summer. Lebour (1926, II) found larvæ from January to March off Alexandria. Lo Bianco (1909) saw many larvæ from July to December. These two observations seem to suggest that there are several spawning periods, and this is confirmed by Frost (1934) who found that south west of Ireland *E. krohnii* spawned from the spring and far out in the autumn. In our material males and females were mature in the 1908—1909 winter collection. But also in the 1910 summer material all large males and females were mature, the females with the spermatophor fixed in the thelycum and the males with a loose spermatophor. It is, therefore, certain that spawning takes place onward through summer and autumn.

Even Claus (1863) observed that there was always only one spermatophore fixed in the thelycum of the female *E. krohnii*, a circumstance which is confirmed by repeated finds in the present material. In other species there are, as a rule, 2 spermatophores and in *E. superba* I have found as many as 8 spermatophores fixed in the thelycum, a proof that the female has taken part in at least 4 copulations. In *E. krohnii*, however, only one spermatophore matures in the male, as a rule the left, but I have had no opportunity of investigating more closely the reason for this.

The *E. krohnii* larvæ are fairly well known. As early as 1863 Claus described the 3rd *Calyptopis* from Messina as well as some *Furcilia* and *Cyrtopia* stages. Later Metschnikow (1869), Sars (1885) and

Lebour (1926, II) described several stages. Frost (1934) has given a survey of these different contributions to the description of the development of the species.

### 10. **Euphausia brevis** H. J. Hansen.

*Euphausia brevis* has a wide distribution in tropical and sub-tropical waters in the Atlantic, Pacific and Indian Oceans. Hansen, who described this species in 1905, found it distributed in the Sargasso Sea and the Mediterranean. *E. brevis* was taken in the Atlantic Ocean between about 35° S. Lat. and about 38° N. Lat. by the Swedish Antarctic, Deutsche Südpolar and British Antarctic Expeditions (Hansen, 1913, Zimmer, 1914, Tattersall, 1924), but it was entirely absent at stations taken up between 11°9′ S. Lat. and 20°41′ N. Lat. In the material from "Bache" Tattersall (1926) found *E. brevis* in the whole of the oceanic area from Chesapeake Bay-Bermudas-Florida Straits where the temperature in the surface at this time of the year — January-March — is below 25° C. Tattersall described *E. brevis* as a surface form, common in the upper 200 metres.

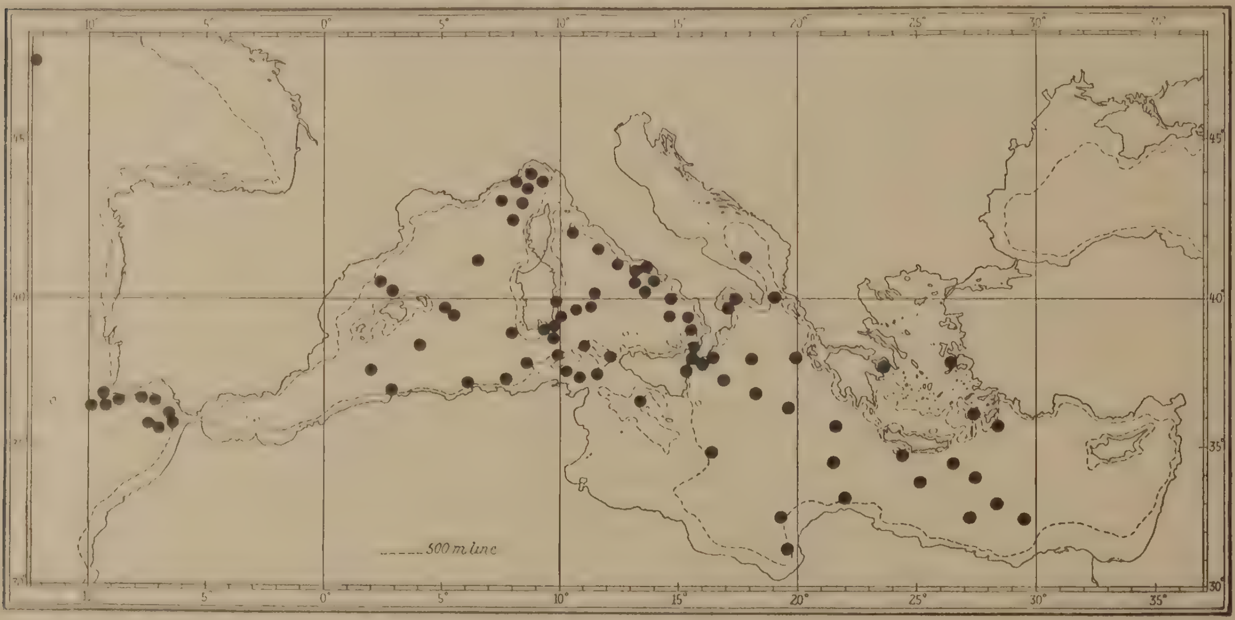

Fig. 11. *Euphausia brevis.* Positive stations 1906, 1908—09, 1910, 1911, 1912.

*Euphausia brevis* is relatively rare in our material from the Atlantic Ocean. In 1906 it was only taken at Station 179, 47°20′ N. Lat. 12°23′ W. Long. (1800 metres of wire) and in 1911 it was taken at 5 stations in the sea west of Portugal between 31° and 41° N. Lat. On the east coast of America it is known up to 40°2′ N. Lat. 68°49′ W. Long.

This known distribution of *E. brevis* in the Atlantic Ocean agrees in many features with the distribution of *T. aequalis* and, as we shall see below, even more with that of *E. hemigibba.*

In the Mediterranean *E. brevis* has been taken in all areas except in the Alboran and Marmara Seas (see Chart, Fig. 11). In the material from 1908—1909 and from 1910 it was not taken in the Atlantic north of Cadiz Bay.

*E. brevis* was taken in the Mediterranean in 1908—1909 at nearly all stations investigated in the areas in which it is found. In the summer somewhat less frequently, only in the Ligurian Sea at all 4 stations examined. The greatest number per half-hour haul was taken, as the table shows, during the winter in the

Ionian Sea, the Tyrrhenian Sea and the Balearic Sea, and in the summer in the Tyrrhenian Sea, the Levant, the Sidra Sea and the Ionian Sea respectively.

In this case, however, I regard as belonging to the Levant, Station 161 situated in the most southerly part of the Aegean Sea directly north west of Rhodes. It is the only station in this southern part of the Aegean Sea and, with its great number of *E. brevis*, it stands out in great contrast to the other stations in the Aegean Sea, where only 1 station out of 5 is positive as regards this species and with the small number of 3 per half-hour haul.

In the majority of areas the number per half-hour haul is considerably larger in the summer than in the winter, in some cases many times greater, but in the Balearic Sea practically speaking the same number have been taken in the summer as in the winter, while in the Ionian Sea more were taken in the winter than in the summer. These two deviations must presumably be due to the placing of the stations within these areas. The central part of the Balearic Sea has been little investigated during the winter and the central part of the Ionian Sea has not been subjected to examination in the summer. The most important area of distribution for *E. brevis* must seemingly be the central Ionian Sea—Sidra Sea—Levant, and, in the western Mediterranean, in the Tyrrhenian Sea.

**Table 9. *Euphausia brevis* H. J. Hansen.**

Number per $^1/_2$ hour haul and frequency. Winter 1908—1909.

| Metres of wire | Cadiz Bay | Balearic Sea | Ligurian Sea | Tyrrhenian Sea | Ionian Sea | Adriatic Sea | Aegean Sea | Total |
|---|---|---|---|---|---|---|---|---|
| 10— 65 | 13 | 36 | 3 | 60 | 160 | 13 | 0 | 61 |
| 100—400 | 3 | 26 | 3 | 29 | 7 | 4 | 2 | 18 |
| > 500 | 2 | 13 | 0.25 | 19 | 23 | 1 | 0 | 14 |
| Total... | 6 | 29 | 2 | 40 | 89 | 9 | 2 | 41 |
| Frequency | 5/7 | 7/7 | 3/3 | 11/13 | 6/6 | 2/2 | 1/1 | 35/56 |

Summer 1910.

| Metres of wire | Cadiz Bay | Balearic Sea | Catalonian Sea | Ligurian Sea | Tyrrhenian Sea | Ionian Sea | Sidra Sea | Levant | Aegean Sea | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 10— 65 | 134 | 73 | 27 | 24 | 183 | 97 | 142 | 256 | 4 | 116 |
| 100—400 | 62 | 12 | 0 | 2 | 80 | 11 | 10 | 11 | 0 | 30 |
| > 500 | 11 | 15 | 7 | 7 | 22 | 9 | 3 | 6 | 2 | 12 |
| Total... | 75 | 37 | 12 | 17 | 98 | 41 | 75 | 91 | 3 | 60 |
| Frequency | 5/8 | 11/20 | 2/4 | 4/4 | 10/13 | 6/8 | 3/3 | 3/5 | 1/5 | 45/99 |

*Euphausia brevis* belongs mainly to the surface layer. The vertical distribution emerges to a certain extent from the table. Calculated for the whole of the material 66 $^0/_0$ of the individuals were taken in the winter in hauls with 10—65 metres of wire and in the summer 75 $^0/_0$ with the same hauls. 15 $^0/_0$ and 8 $^0/_0$ respectively were taken in hauls with more than 500 metres of wire. For this species also we have the usual condition that the individuals in their vertical distribution are nearer to the surface in the summer.

The lowest temperature in the surface layer at the stations at which *E. brevis* was taken during the winter was that at Station 35 in the Ligurian Sea, namely 12°80, but from the surface layer downwards it rose to 13°50 at 500 metres, otherwise at the places where *E. brevis* was taken in the western Mediterranean it was everywhere above 13° and 14° and in the eastern Mediterranean above 15° and 16°. In Cadiz Bay the temperature was above 14° and 15°. That *E. brevis* occurs so much more abundantly in the Ionian Sea-Levant than in other areas suggests that its optimal temperature range lies somewhat high, and the distribution in the Atlantic Ocean shows that it is hardly to be found further north and south than the mean annual surface isotherm for 15°, corresponding to a temperature of 13°—14° at the depths at which the species normally is to be found. In the Atlantic it is not found, or only rarely so, in the central area near to the Equator where the surface temperature exceeds 25°. It is remarkable that no *E. brevis* was found in the Alboran Sea either in the summer or winter material. It will be remembered that neither was *T. aequalis* taken in this area during the summer, and only in small quantities, and rarely, in the winter. In contrast to this is *E. krohnii* which revealed one of its most abundant occurrences in the Alboran Sea. Smaller individuals of *E. krohnii* and *E. brevis* than 6—7 mm. in length are very difficult to distinguish from each other. I cannot, therefore, assert with any degree of certainty that there are not to be found a few *E. brevis* in the samples from the Alboran Sea which consist of up to 1400 *E. krohnii*. In the case of such large catches only random samples are thoroughly examined, but, in any event, we can safely draw the conclusion that, if it is found in the Alboran Sea *E. brevis* must be very rare there, and this conclusion is satisfactory in the present case.

In our material there were mature individuals, including females with a spermatophore in the thelycum, at several of the stations taken in the winter of 1908—1909, also in the Tyrrhenian and Ligurian Seas. Thus spawning must also take place in these areas. The spawning must begin early in the spring and can presumably take place far on into the year. I have, however, no observations of the degree of maturity of females in the summer material and nothing, therefore, can be said with certainty regarding the duration of the spawning period.

As *E. brevis* in the Mediterranean mainly belongs to the surface layer it will spread with the movements of this layer. In other words, there will be a certain amount of communication between the various areas, but the possibilities of entering the Alboran Sea should mainly be in the form of an invasion through the Straits of Gibraltar. Cadiz Bay is undoubtedly one of the outposts of *E. brevis* in the Atlantic Ocean. The stock is large in the summer, but nevertheless it seems as if, just as in the case of *T. aequalis* and other species, transport with the in-flowing surface water cannot play any noteworthy part. Perhaps, however, investigations at other periods of the year would present another picture in this respect.

### 11. **Euphausia hemigibba** H. J. Hansen.

*Euphausia hemigibba* was described by H. J. Hansen in 1911 in his report from the "Siboga" Expedition. Prior to that date it had always been confused with *Euphausia gibba* G. O. Sars. It is taken from about 42° N. Lat. to about 36° S. Lat. in the Atlantic Ocean, and in tropical and sub-tropical waters in the Indian and Pacific Oceans. As in the case of *E. brevis* and *T. aequalis* there is an area near the Equator in the Atlantic Ocean where the species is not taken, namely between 8°43′ S. Lat., 11°55′ W. Long. and 17°28′ N. Lat., 29°42′ W. Long. (Hansen, 1913, Zimmer, 1914, Tattersall, 1924).

On the "Terra Nova" Expedition the intermediate negative stations were investigated with vertical hauls right down to 3000 metres whereas only the surface layer was examined on the other two expeditions. Tattersall (1926) found it at the same stations as *E. brevis* in the Chesapeake Bay—Bermudas—Florida Straits area. It was often taken near the surface but with a maximum abundance in 100 metres. It thus belongs chiefly to the upper water layers and has a distribution which agrees well with that of *E. brevis*.

In our material from the waters south west of Ireland 1906 *E. hemigibba* was taken at two stations, 62 and 180, in small numbers and in hauls with 1500 and 1800 metres of wire. The most northerly position was 50°25′ N. Lat., 12°44′ W. Long. Thus it was taken slightly further north than *E. brevis*.

In the Atlantic Ocean in 1911, *E. hemigibba* was taken at the majority, 4 in all, of the stations at which also *E. brevis* was taken. The most southerly position was station 376, 34°41′ N. Lat., 16°14′ W. Long. At these stations in 1911 it was also taken in small quantities, a maximum of 53 in a half-hour haul and with

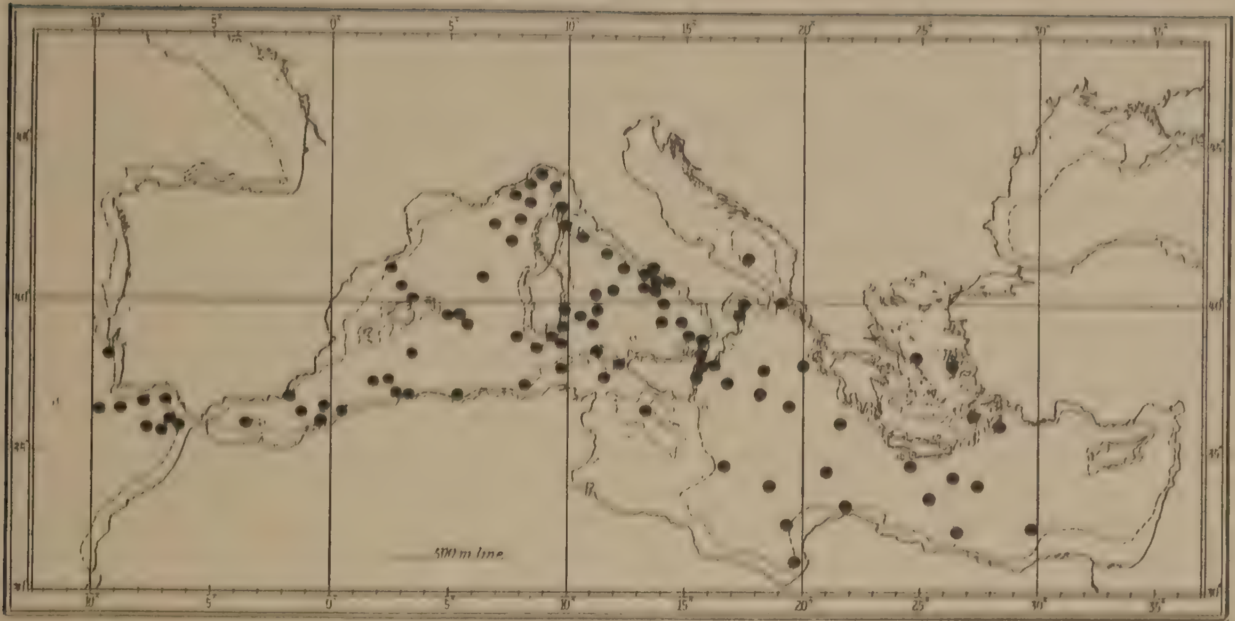

Fig. 12. *Euphausia hemigibba.* Positive stations 1908—09, 1910, 1911, 1912.

15—47 metres of wire. Records of catches in the material from 1908—1909 and 1910 emerge from the chart Fig. 12 and from the accompanying Table 10.

In the various areas *E. hemigibba* reveals a great measure of agreement with *E. brevis* in both frequency and number per half-hour haul.

### Table 10. *Euphausia hemigibba* H. J. Hansen.

Number per $^1/_2$ hour haul and frequency. Winter 1908—1909.

| Metres of wire | Cadiz Bay | Alboran Sea | Balearic Sea | Ligurian Sea | Tyrrhenian Sea | Ionian Sea | Adriatic Sea | Total |
|---|---|---|---|---|---|---|---|---|
| 10—65 | 0 | 0 | 48 | 8 | 57 | 205 | 27 | 76 |
| 100—400 | 6 | 12 | 62 | 3 | 53 | 5 | 1 | 26 |
| 500 | 5 | 1 | 1 | 2 | 22 | 88 | 5 | 23 |
| Total | 6 | 1 | 13 | 1 | 19 | 131 | 18 | 49 |
| *Frequency* | 4/7 | 3/8 | 7/7 | 3/3 | 12/13 | 6/6 | 2/2 | 37/56 |

Summer 1910.

| Metres of wire | Cadiz Bay | Alboran Sea | Balearic Sea | Catalonian Sea | Ligurian Sea | Tyrrhenian Sea | Ionian Sea | Sidra Sea | Levant | Aegean Sea | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10—65 | 235 | 0 | 201 | 6 | 20 | 116 | 80 | 89 | 47 | 5 | 130 |
| 100—400 | 31 | 2 | 120 | 0 | 19 | 271 | 316 | 93 | 108 | 30 | 151 |
| 500 | 50 | 0 | 78 | 8 | 11 | 200 | 62 | 43 | 32 | 3 | 81 |
| Total | 106 | 2 | 143 | 7 | 18 | 191 | 146 | 77 | 55 | 8 | 122 |
| *Frequency* | 4/8 | 2/10 | 14/20 | 2/4 | 4/4 | 12/13 | 6/8 | 3/3 | 2/4 | 3/6 | 52/99 |

In 1910 *one* individual was taken with 1000 metres of wire at Station 234 in the Bay of Setubal, but otherwise its distribution outside Gibraltar in these two collections of material is confined to Cadiz Bay. At this place it was taken at 4 out of 7 and 4 out of 8 stations respectively in the winter and summer, the frequency being slightly less than that of *E. brevis* in this area. In the Mediterranean *E. hemigibba* was taken with a slightly greater frequency than *E. brevis*, namely at 33 out of 40 stations in the winter and 48 out of 72 stations during the summer. *E. brevis* was taken at 30 out of 40 and 40 out of 72 stations respectively in the Mediterranean.

In the winter of 1908–1909 *E. hemigibba* was taken at 3 stations in 8 in the Alboran Sea and in the summer of 1910 at 2 stations out of 10. *E. brevis* was entirely absent in this area. *E. hemigibba* was not present in the winter at 1 out of 13 stations in the Tyrrhenian Sea and it was missing at the only station in the Aegean Sea during this period of the year. Otherwise it was taken at all the stations investigated in the Balearic, Ligurian, Ionian and Adriatic Seas. In the summer of 1910 it was only in the Ligurian and Sidra Seas that *E. hemigibba* was taken at all stations investigated.

Similarly with *E. brevis* the number per half-hour haul was greatest in the Ionian, Tyrrhenian and Balearic Seas in the winter, and greatest in the same areas also in the summer. In contrast to *E. brevis* the number decreases from the Ionian Sea eastwards through the Sidra Sea and the Levant, and *E. hemigibba*, therefore, has the bulk of its distribution more in a western direction. It has thus, as we have mentioned, been taken in the Alboran Sea even though the quantity has been small.

The vertical distribution of *E. hemigibba* is entirely in accordance with that of *E. brevis* in the material from the winter of 1908–1909, namely, a maximum in the hauls taken with 10–65 metres of wire. In the summer of 1910 a substantial part was also taken with these hauls, but the maximum, however, is to be found in hauls with 100–400 metres of wire. *E. hemigibba* seems, in other words, to have a somewhat deeper distribution, possibly in particular at a depth of about 100 metres as TATTERSALL discovered in the western Atlantic.

If such is the case we also understand that *E. hemigibba* must enter the Alboran Sea with the upper layers of the intermediate layer. In the Alboran Sea no individuals have been taken in the upper zone. The majority were taken in hauls with 300 metres of wire and, in all, amounted to 16 individuals. One individual was taken with 500 metres of wire and one with 2000 metres. The latter was taken with a ring trawl (C. 200) and this specimen was thus fished at a depth of 1000–1300 metres.

Assuming that *E. hemigibba* has its maximum distribution at a depth of about 100 metres it will there have very uniform temperature conditions between 13°–16° C. in the whole of the Mediterranean.

Its distribution in the Atlantic Ocean suggests that the northern and southern limits coincide with temperatures of 12° or 13° at a depth of 100 metres, corresponding approximately to the mean annual isotherm for 14° or 15° C. at the surface. As the species is entirely lacking or, in any event, very rare in an area near to the Equator within the belt having a temperature of 25° or 26° at the surface, this suggests that *E. hemigibba*, in common with *E. brevis* and *T. aequalis*, has its maximum distribution in the Atlantic in the two sub-tropical convergence areas, where the water layers with a temperature between 15° and 25° reach their greatest magnitude.

Judging by our material, it seems as if spawning of *E. hemigibba* takes place in the winter and spring and to a smaller extent in the summer. There are many small larvæ, taken in the upper water layers in the Straits of Messina in February and March 1911 and similarly at individual stations during the winter of 1909 (Station 26, off Naples, 19/1/1909). I have several times noted that from the summer of 1910 there are two groups of sizes of individuals in the samples, e. g. from station 144 in the Ionian Sea. At station 265 in the Atlantic there were taken, on 20/3/1911, two males with loose spermatophores.

### 12. Euphausia gibboides Ortmann.

*Euphausia gibboides* is only known from tropical and sub-tropical waters in the Atlantic and Pacific. In the Atlantic Ocean it has been taken in the northern and southern equatorial current, in the Gulf of Guinea and in the Sargasso Sea. In the eastern Atlantic Ocean it has previously been taken up to 32°30′ N. Lat. and in the western Atlantic to 37°40′ N. Lat. (Hansen, 1912, 1915). During the Deutsche Südpolar Expedition it was taken at several localities between 17°28′ N. Lat. and 32°8′ S. Lat. (Zimmer 1914)

*E. gibboides* has rarely been taken at the surface, but neither is it a deep water form. Tattersall (1926) found it most commonly at a depth between 150 and 75 metres and none has been taken at a greater depth than 750 metres. In our material *E. gibboides* was taken at 2 stations in Cadiz Bay during the winter of 1908—1909 and at 5 stations there in the summer of 1910. In the Atlantic Ocean otherwise, during the years in question and the year 1911, it was not taken. *E. gibboides* was taken in numbers up to 30 per half hour, the average for all hauls being 12 per half-hour. The majority of individuals were taken in hauls with 300 metres of wire, but if we calculate the numbers per half-hour we find that with 25 metres of wire 20 individuals were taken, with 300 metres of wire 12, and with 600—1600 metres 8, all per half-hour haul. All hauls were made at night. There can therefore be no doubt but that *E. gibboides* belongs to the upper, warm water layer in the Atlantic Ocean. At 150 metres the temperature in Cadiz Bay is from 14°20 to 14°87, and it rises towards the surface. All these data regarding the distribution of the species suggest that *E. gibboides* is constrained to inhabit water layers of a temperature above 14°—15°. The isotherm for 15° at a depth of 100 metres (Schott, 1912) coincides well with the northern and southern limits for the records known

### 13. **Thysanoessa inermis** Krøyer.

*Thysanoessa inermis* is characterised as arctic-boreal. Kramp (1913) gives a good survey of the distribution of the species and puts its southern boundary at the continental shelf from Brittany north-westwards and northwards along the west coast of Ireland. The species is confined to coastal waters. On the western side of the Atlantic Ocean it is stationary in the Gulf of Maine and Bigelow (1926) assumes that it reproduces with success in any event as far to the west as to Cape Cod. Outside the Atlantic Ocean including the arctic waters lying to the north thereof, *T. inermis* is known from the Behring Straits and the north Pacific (Hansen 1915).

In our material there are in all 69 individuals, 1 from station 82, 1905, 1 from station 56 and 67 from station 166, 1906. These stations lie inside the 1000 metre isobath on the shelf south-west of Ireland. 64 of the 67 specimens from station 166 were of the *neglecta* form.

### 14. **Thysanoessa longicaudata** Krøyer.

*Thysanoessa longicaudata* has almost the same distribution as *T. inermis*, but it is more oceanic. On the east coast of America it has been taken down to 37°40′ N. Lat., 70°37′ W. Long. This is outside the continental shelf between Cape Cod and Cape Hatteras (Hansen 1915). Bigelow (1926) assumes that possibly it is stationary in the Gulf of Maine. Kramp (1913), who gives a good survey of the distribution of *T. longicaudata* in European waters, found that the southern limit lay a little more north than that for *T. inermis*, inasmuch as it was not taken further south than to the area south west of Ireland and not eastward to the mouth of the Channel and the Bay of Biscay.

*T. longicaudata* in our material was taken at 2 stations in 1905, 9 stations in 1906 and 2 stations in 1911. All stations were situated south and sourth-west of Ireland outside the 200 metres isobath. The most southerly position was station 267, 42°37′ N. Lat., 18°6′ W. Long. true west of Cape Finisterre. At station 178, on 2/9/1906, as many as 440 *T. longicaudata* were taken in a haul with 1800 metres of wire and of 2 hours, duration (Y. 330). Otherwise it was only taken in small quantities and in hauls with 47—2800 metres of wire.

### 15. **Thysanoessa gregaria** G. O. Sars.

Hansen (1915) remarks in regard to *Thysanoessa gregaria*: "This species is known from the temperate north Atlantic, the temperate south Atlantic, and southward in the sub-antarctic ocean to lat. 53°34′ S., furthermore, from the south Pacific and the temperate and boreal north Pacific, but it has never been taken in the tropical area and, so far as I can see, perhaps not in the sub-tropical belts of any ocean." In the Atlantic Ocean it is thus known from the waters around the Falkland Islands in the south to the west coast of Ireland in the north, but apparently it is not found in the tropical area. ZIMMER (1914), therefore, regards it also as a bi-polar species, but TATTERSALL (1924) expresses himself in a somewhat more reserved manner, inasmuch as he says "Of wide distribution in the waters of the north and south temperate zones, but rarely found in tropical waters." TATTERSALL (1927) reports *T. gregaria* at several localities in the oceanic area outside Chesapeake Bay and in the waters of Bermudas—Florida Straits. On two occasions it was taken in the surface layer, but seemed to be more common under 200 metres than over.

*T. gregaria* in our material was not taken at any of the many stations south west of Ireland or in the Bay of Biscay, but it was captured in considerable numbers in hauls with 25 and 47 metres of wire at Stations 265 and 266 in the Atlantic in 1911, between about 39° and 41° N. Lat. and 21° to 23° W. Long.

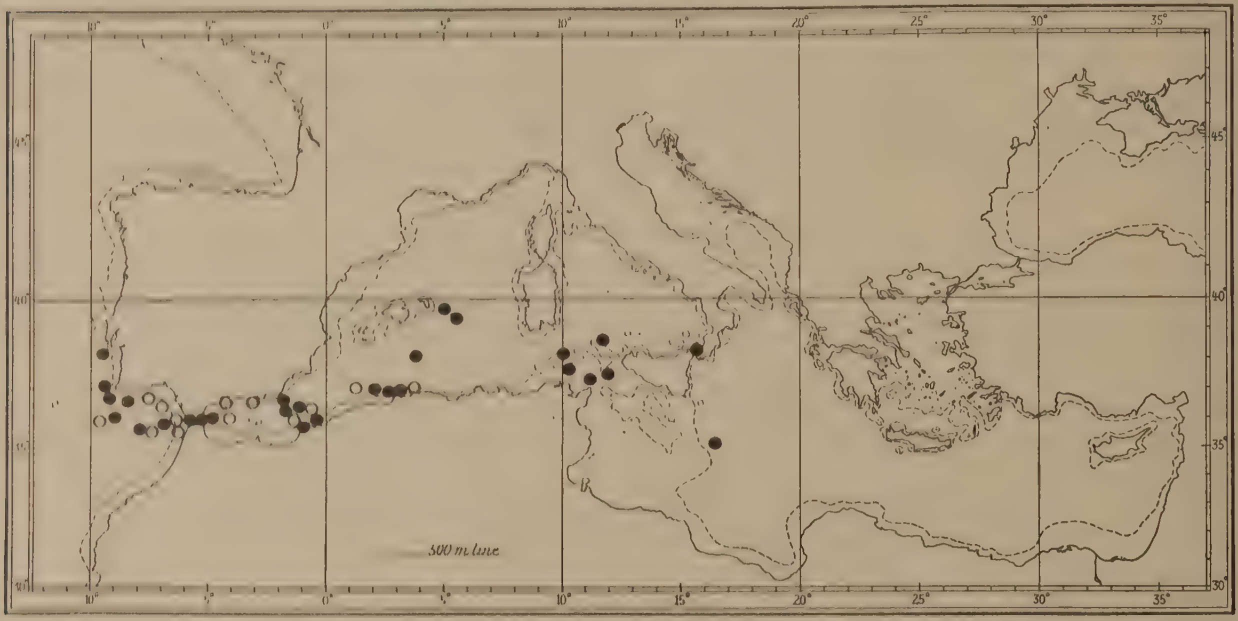

Fig. 13. *Thysanoessa gregaria.* Positive stations, ○ Winter 1908—1909, ● Summer 1910.

The finds in the 1908—1909 and 1910 material proceed from the chart, Fig. 13, and the number per half-hour haul in the usual intervals are to be found in the accompanying Table 11.

From Cadiz Bay *T. gregaria* has been taken so far northwards along the coast of Portugal as to the Bay of Setubal. In the winter of 1908—1909 it was taken in these waters at 6 out of 7 stations. It was taken during the winter of 1908—1909 through the Straits of Gibraltar in the Alboran Sea and in the southern Balearic Sea as far as to station 47, 3°12 E. Long. Furthermore, it was taken in the summer of 1910 in the central Balearic Sea (Stations 115 and 116), also in the area between Tunis—Sardinia—Sicilia, in the Pantellaria Channel, near Messina and as far east in the Ionian Sea as station 143, 16°25′ E. Long. It was not captured in the Catalonian and Ligurian Seas or the central and northern Tyrrhenian Sea, nor in the eastern Mediterranean outside of the single locality in the Ionian Sea.

The great frequency shown by the Stations in Cadiz Bay decreases inwards in the Mediterranean as the table indicates.

The number per half-hour haul rises somewhat from Cadiz Bay to the Balearic Sea in the winter of 1908—1909 but decreases, on the other hand, from west to east in the summer of 1910. In the light of

Table 11. *Thysanoessa gregaria* G. O. Sars.
Number per 1/2 hour haul and frequency. Winter 1908—1909.

| Metres of wire | Cadiz Bay | Alboran Sea | Balearic Sea | Total |
|---|---|---|---|---|
| 10— 65 | 31 | 0 | 0 | 31 |
| 100—400 | 6 | 19 | 36 | 15 |
| ≥ 500 | 7 | 1 | 1 | 5 |
| Total... | 11 | 15 | 19 | 13 |
| Frequency | 6/7 | 5/8 | 2/7 | 13/56 |

Summer 1910.

| Metres of wire | Cadiz & Setubal Bays | Alboran Sea | Balearic Sea | Tyrrhenian Sea | Ionian Sea | Total |
|---|---|---|---|---|---|---|
| 10— 65 | 2 | 0 | 0 | 1 | 0 | 2 |
| 100—400 | 7 | 7 | 6 | 6 | 1 | 6 |
| ≥ 500 | 15 | 2 | 5 | 0 | 2 | 8 |
| Total... | 8 | 6 | 6 | 4 | 2 | 6 |
| Frequency | 7/9 | 8/10 | 10/20 | 2/13 | 1/8 | 28/60 |

the decreasing frequency and distribution in the Mediterranean otherwise we must draw the conclusion that *T. gregaria* is a native of the Atlantic and is transported with the surface layer current through the Straits of Gibraltar and eastwards through the southern part of the Mediterranean. That it is carried further in summer than in winter is a natural consequence of the higher velocity of the current in the summer than in the winter (J. N. NIELSEN 1912). Outside its proper area of distribution it gradually decreases as we proceed eastwards. This species has naturally also a certain tendency to "shoaling" and this may explain the increasing number per half-hour haul from west to east during the winter. It must be pointed out, however, that the various water layers have not by any means been so systematically investigated in the winter as in the summer.

As far as our material is concerned we must, as previously stated, take it for granted that the animals have been taken in the upper position of their vertical distribution because nearly all hauls were made at night. Nevertheless, there is a striking difference between the vertical distribution in Cadiz Bay and that in the Mediterranean.

In the winter of 1908—1909 the maximum number per half-hour haul was taken in the upper water layer, in hauls in Cadiz Bay with 10—65 metres of wire.

Considerably fewer individuals were taken from the deeper water layers. In the summer of 1910 the maximum number was taken in hauls with more than 500 metres of wire, but some were also taken in higher layers with 25, 65 and 300 metres of wire. Inside Gibraltar only one individual was taken in the interval 10—65 metres of wire, in the Messina Strait at Station 193 with 10 metres of wire. Otherwise the maximum number was taken in hauls with 300 metres of wire and a small number in hauls with more than 500 metres of wire down to 2000 metres. In other words *T. gregaria* was taken in the Mediterranean mainly at depths of about 150 metres, that is to say, in the lower layers of the in-flowing water of Atlantic origin. The water here has a salinity of about 38 ‰ and a temperature of 13°—14°.

*T. gregaria* is the only species of the genus *Thysanoessa* which is found in the Mediterranean and even if it is at all times to be found there it is scarcely stationary in the proper sense of the word. Its occurrence must be presumed to be dependent upon a continued supply from the Atlantic Ocean. BIGELOW (1926) has found similar conditions for the occurrence of the species in the Gulf of Maine. It is not easy to say what it is that prevents *T. gregaria* from being stationary in the Mediterranean so long as our knowledge of the limits of its distribution in the Atlantic Ocean is incomplete. Possibly it is the combination of high temperature and high salinity which lies outside of the range of toleration of the species.

### 16. Nematoscelis megalops G. O. Sars.

*Nematoscelis megalops* has an oceanic-Atlantic distribution. It is known from the Irminger Sea south-west of Iceland and west and south-west of the Faroes. Furthermore, it has been taken in the Irish Sea and west of Ireland, and it travels into the northern part of the North Sea and occasionally into the Skagerak. It is also fished in the Bay of Biscay and near the Azores and in the Mediterranean. On the western side of the Atlantic Ocean it has been captured in the waters from the east of Newfoundland to outside of Cape Hatteras. In the southern Atlantic *N. megalops* has been taken in the area between Buenos Ayres—Tristan da Cunha—Cape of Good Hope. It has not been taken between about 28° N. Lat. and about 35° S. Lat. (H. J. Hansen, 1908, 1915, Zimmer, 1914, Kramp, 1913, Tattersall, 1926).

Kramp reports it as found in the Barents Sea, where, however, it must be very rare. In our investigations from 1925—1931 we have never found it in the waters off Møre, Norwegian west coast. Tattersall found it in the area Chesapeake Bay—Bermudas—Florida Straits at two stations in company with *M. norvegica* and *E. krohnii* and for this reason he characterises it as a northern or boreal species. In the Skagerak it occurs in company with *M. norvegica* in Atlantic boreal water masses.

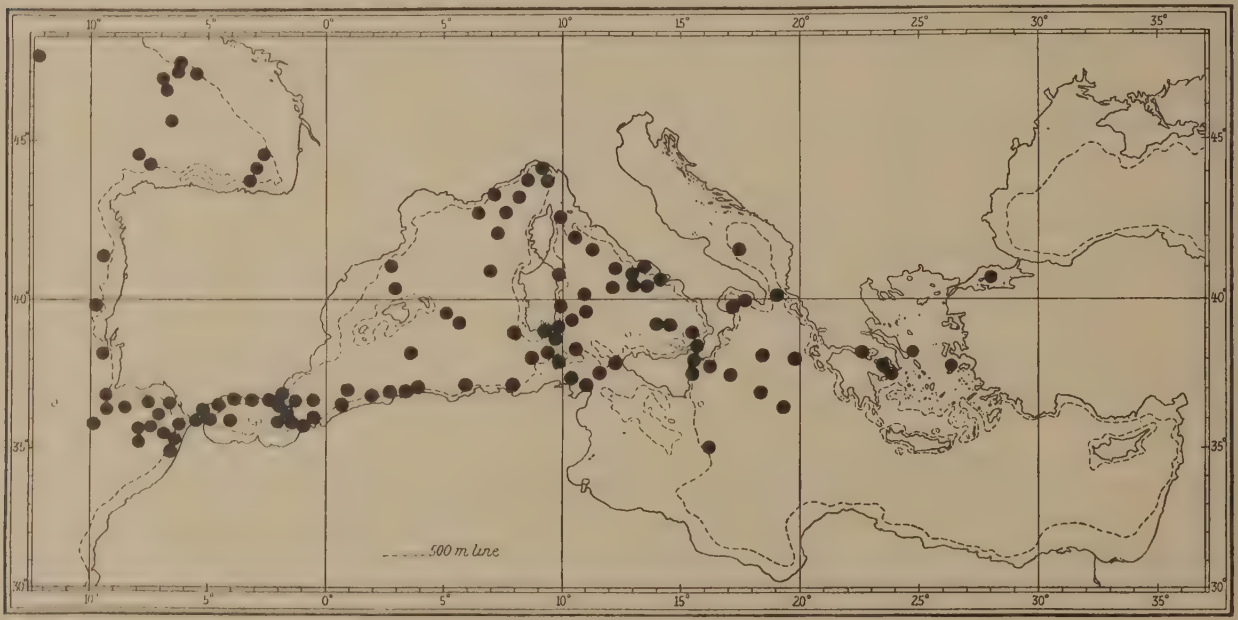

Fig. 14. *Nematoscelis megalops*. Positive stations 1906. 1908—09, 1910, 1911.

Fowler (1905) has investigated its vertical distribution in the Bay of Biscay. He found it down to 500—750 fathoms with a maximum abundance between 50 and 75 fathoms.

These particulars show that *N. megalops* has a distribution which broadly conforms to that known to us in the case of *E. krohnii*, though the distribution of the latter species in the South Atlantic is not confirmed. *N. megalops*, however, has a somewhat deeper vertical distribution. We may characterise *N. megalops* as temperate-Atlantic, inasmuch as its distribution in boreal waters is limited to water masses of Atlantic origin. If we take it for granted that its main distribution is to be found at a depth of about 100 metres, it is, broadly speaking, confined to waters the temperatures of which are between about 8° and 17° C. Accordingly it should find conditions for existence in the intermediate layers over the whole of the Mediterranean, and it is also previously known from several localities in the western Mediterranean (Tattersall, 1909, Colosi, 1922, Denis, 1929).

In our material it was taken in the Atlantic Ocean in all the years of investigation. It was taken from

Cadiz Bay along the north and north-west coast of Spain, inmost in the Bay of Biscay and from here along the slope past the mouth of the Channel, south and south-west of Ireland. Over the entire distance it was taken only outside the isobath for 200 metres. We have it in material from as far north as station 89, 23/6/1906, 55°45′ N. Lat., 9°35′ W. Long. and in 1911 it was taken as far south as 34°41′ N. Lat. and as far west as 22°49′ W. Long. At the last mentioned place it was only taken in small numbers in night hauls from the uppermost water layers.

The Chart Fig. 14 and the accompanying Table 12 show the results of the investigations in 1908—1909 and 1910.

In the material as a whole *N. megalops* was taken at 46 stations in 56 taken up during the winter expedition and at 64 out of 99 during the summer. The average number per half-hour haul was 38 and 159 respectively. Both the frequency and the catches were greater in the Mediterranean than outside. In the winter of 1908—1909 *N. megalops* was taken at all the stations investigated in all areas except in the Tyrrhenian and Ionian Seas where it was taken at 10 out of 13 and 5 out of 6 stations. The smallest catches were also made in these two areas. In 1910 *N. megalops* was not taken in the Levant. Otherwise it was captured in all the areas investigated including the Marmara Sea, though it was only in the Ligurian Sea that it was taken at all stations. It had its greatest frequency and was taken in the greatest numbers in the Alboran and Balearic Seas.

**Table 12. *Nematoscelis megalops* G. O. Sars.**
Number per $^1/_2$ hour haul and frequency. Winter 1908—1909.

| Metres of wire | Atlantic | Cadiz Bay | Alboran Sea | Balearic Sea | Ligurian Sea | Tyrrhe-nian Sea | Ionian Sea | Adriatic Sea | Aegean Sea | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 10— 65 | 8 | 2 | 19 | 41 | 21 | 3 | 6 | 2 | 0.5 | 14 |
| 100—400 | 7 | 4 | 129 | 160 | 88 | 8 | 11 | 1 | 37 | 42 |
| > 500 | 3 | 2 | 281 | 73 | 3 | 28 | 24 | 350 | 0 | 60 |
| Total... | 6 | 2 | 155 | 87 | 35 | 12 | 16 | 141 | 19 | 38 |
| Frequency | 4/7 | 6/7 | 8/8 | 7/7 | 3/3 | 10/13 | 5/6 | 2/2 | 1/1 | 46/56 |

Summer 1910.

| Metres of wire | At-lantic | Cadiz Bay | Alboran Sea | Ba-learic Sea | Cata-lonian Sea | Ligu-rian Sea | Tyrrhe-nian Sea | Ionian Sea | Sidra Sea | Aegean Sea | Mar-mara Sea | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10— 65 | 0 | 2 | 7 | 21 | 8 | 9 | 5 | 5 | 0 | 2 | 0 | 9 |
| 100—400 | 55 | 29 | 350 | 275 | 28 | 319 | 250 | 68 | 1 | 102 | 10 | 210 |
| ≥ 500 | 14 | 8 | 873 | 329 | 196 | 107 | 154 | 36 | 0 | 35 | 2 | 193 |
| Total... | 32 | 13 | 341 | 234 | 136 | 145 | 153 | 36 | 1 | 44 | 7 | 159 |
| Frequency | 6/15 | 7/8 | 9/10 | 17/20 | 2/4 | 4/4 | 10/13 | 5/8 | 1/3 | 3/6 | 1/2 | 64/99 |

Consequently *N. megalops* is found in the Mediterranean in greatest numbers in the Alboran-Balearic Seas. As the table shows it agrees so well in frequency and numbers with *E. krohnii* that we must presume that this distribution is characteristic of the special fauna element to which these two species belong.

The vertical distribution shows that *N. megalops* was taken in greatest numbers in hauls with more than 500 metres of wire in the winter and in hauls with 100—400 metres of wire in the summer. The vertical distribution of *E. krohnii* lay a stage higher.

With regard to the spawning of *N. megalops* little is to be found in the literature. In material taken by the "Maia" near Capri Lo Bianco (1909) found a female of the genus *Nematoscelis* with eggs in the ovisac in April. He found young from June to March and he assumed that possibly they could be found all the year round. What species of *Nematoscelis* this was cannot be stated as TATTERSALL (1909) who determined this material makes no mention of any egg-bearing female.

In our material there are females with eggs in the ovisac from several stations from 10/5/06—4/9/06, from 21/2/09—9/3/09 and from 15/6/10—10/9/10. Young animals were taken in corresponding periods, 5/6/06—3/9/06, 19/1/09—22/2/09, 15/6/10—10/9/10 and in addition from Messina 1—13/3/11.

These observations suggest a fairly long spawning period, which, as a matter of fact, also applies to other egg-bearing species. This is particularly reasonable in the case of species which live under the fairly uniform hydrographical conditions in intermediate water layers.

### 17. **Nematoscelis tenella** G. O. Sars.

*Nematoscelis tenella* has a wide distribution in tropical and sub-tropical waters in the Atlantic, Pacific and Indian Oceans. In the first-mentioned it has been taken between about 40° N. Lat. and 35° S. Lat. (ZIMMER, 1914, HANSEN, 1912, BIGELOW, 1926, TATTERSALL, 1926). It is a deep water form in a greater degree than any other species of the genus *Nematoscelis*. Thus, TATTERSALL found it mainly below 200 metres.

*N. tenella* in our material was only taken in Cadiz Bay in 1908—1909 and 1910 at 3 and 4 stations respectively. In all 10 individuals were taken during the winter of 1908—1909 and 154 during the summer of 1910. 82 $^0/_0$ of the number per half-hour haul was taken with 300 metres of wire (during the night) and none at a less depth. The remainder were taken in hauls with 1000 to 2000 metres of wire. The majority were thus taken at depths with a temperature of 14°—15°. If we take 200 metres as a mean depth for the distribution of this species the isotherm for 13°—14° at this depth will coincide well with the known distribution of this species in the Atlantic Ocean between about 40° N. Lat. and about 35° S. Lat. South of Africa water of this temperature penetrates with the Agulhaes Current almost to 40° S. Lat. and in these waters *N. tenella* was also found by the "Challenger" Expedition (SARS, 1885). If *N. tenella* can also reproduce at such a low temperature as about 13° there appears to be nothing to prevent it inhabiting and spreading over the Mediterranean. The explanation of its failure to pass through the Straits of Gibraltar must, no doubt, presumably be that the species never stays for any length of time in the higher water layers which flow inward through the Straits.

### 18. **Nematoscelis microps** G. O. Sars.

As previously mentioned *Nematoscelis microps* prior to 1910 included *Nematoscelis atlantica*, but enough information is given in the literature to show that *N. microps* is known from tropical and sub-tropical waters in the Atlantic, Pacific and Indian Oceans. ZIMMER (1914) found it together with *N. atlantica* in the Atlantic Ocean from about 21° N. Lat. to about 32° S. Lat., but *atlantica* was taken in 10 times greater quantities. HANSEN (1915) found *N. microps* off the east coast of America between 40° and 38° N. Lat. in addition to a locality in the Caribbean Sea at 15° N. Lat. TATTERSALL (1926) found it in the oceanic area between Chesapeake Bay—Bermudas—Florida Straits and he found its maximum distribution between 200 and 700 metres. In one case it was also taken at the surface. TATTERSALL (1909) also reports *N. microps* in the Mediterranean from material collected by the "Maia" and "Puritan", but as this report was made prior to 1910 it cannot be relied upon. COLOSI (1917) states that he found 7 specimens of *N. microps* in material from the "Washington" Expedition, taken in a locality east of Sardinia. As far as I can see the statement is based on a determination of the males according to the formation of the endopodite of the first pair of pleopods. His text is accompanied by a drawing which is reproduced here in Fig. 15.

The inner lobe is here drawn in an unusual projection, but if we measure the various processes it emerges that the processus proximalis, which is stouter, is also longer than the other processes. This fact, however, as ZIMMER (1915) has shown, gives no reliable character specific for *N. microps*. In young males of *N. atlantica* processus proximalis is also stouter and longer than the other processes. Moreover, in the specimen drawn by Colosi processus terminalis is longer than processus spiniformis.

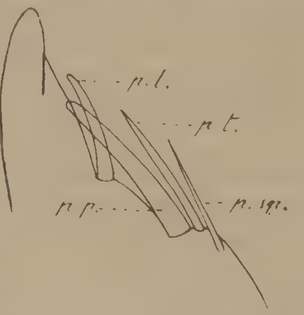

Fig. 15. The median and inner lobe of the copulatory organ of a specimen determined by Colosi as *N. microps*. (After Colosi).

According to H. J. Hansen's description (1910, page 107) the processus terminalis in *N. microps* is always shorter than the processus spiniformis, and among all the males of *N. microps* which I have determined, also by measurement, I have never observed that the processus terminalis can be longer than the processus spiniformis. It is possible that the projection in Fig. 15 is such that a measurement of the length of the various processes does not give a proper result, but, in any event, I cannot consider the particular figure as a proof that Colosi's determination is correct in this case. In 1922 Colosi also reports *N. microps* in the Straits of Messina, but at the same time he also makes a reservation as to whether *N. atlantica* can be maintained as a valid species. As I have previously stated, *N. microps* and *N. atlantica* can be determined with certainty by measuring the diameter of the eye and the carapace length, and these determinations also give reliable results for females and young individuals. As such measurements for determination have not previously been made, the literature gives no safe data for determination as to whether *N. microps* occurs with certainty in the Mediterranean. Colosi's statement, which is given after Hansen had described *N. atlantica*, is possibly correct, but doubtful.

### 19. Nematocelis atlantica H. J. Hansen.

Hitherto *Nematoscelis atlantica* has not been taken in waters outside the Atlantic, where it is found in tropical and sub-tropical areas with approximately the same distribution as *N. microps* (Zimmer, 1914, Hansen, 1915). Curiously enough it was not found by Tattersall (1926) in the oceanic area between Chesapeake Bay—Bermudas—Florida Straits. From the Mediterranean this species is reported with certainty by Zimmer (1915) who, in the vicinity of Naples, only found this species and not *N. microps*.

In the material which I have sifted there are many young individuals, and to some extent also dried up specimens which can hardly be determined with accuracy, even by measurement. But of the several hundred specimens which could be determined I have only found *N. atlantica* from east of Gibraltar whereas both species have been taken together in Cadiz Bay. As a working hypothesis I have therefore adopted the point of view that only *N. atlantica* is commonly found in the Mediterranean, and if, on the whole, *N. microps* is found there it must be very rare and, in such an event, cannot be stationary on the inside of Gibraltar.

**Table 13. *Nematocelis microps* G. O. Sars.**
Number per $^1/_2$ hour haul and frequency.

| Metres of wire | Cadiz Bay | |
|---|---|---|
| | winter 1908—1909 | summer 1910 |
| 25 | 0 | 17 |
| 300 | 2 | 39 |
| ≥ 1000 | 2 | 19 |
| Total... | 2 | 26 |
| Frequency | 2/7 | 6/8 |

On the basis of this assumption we obtain the distribution for the two species *N. microps* and *N. atlantica* which is shown by the chart Fig. 16. From this it emerges that neither of the species has been taken within the isobath for 200 metres, and to a great extent only outside 1000 metres. For this reason the frequency of these two species in the various areas (vide the accompanying tables) has little of interest to show, inasmuch as the frequency is dependent upon how many stations are taken in shallow and deep waters.

*N. microps*, which has not been taken north of the Bay of Setubal (38°10′ N. Lat.), was taken at 8 stations in all, 2 in the winter of 1908—1909 and 6 in the summer of 1910. In the Atlantic *N. atlantica* was taken a little further north than *N. microps*, namely, up to station 81 (41°32′ N. Lat.), and it was taken at 5 stations in all during the winter and 7

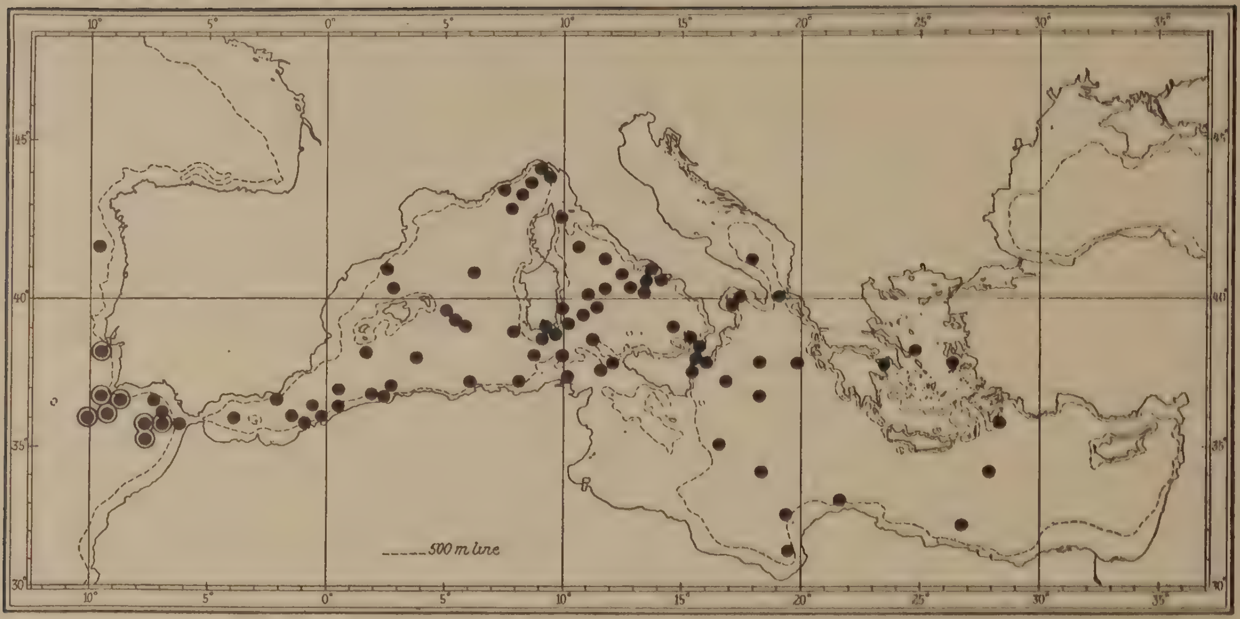

Fig. 16. ● *Nematoscelis atlantica*, ○ *Nematoscelis microps*. Positive stations 1908—09, 1910, 1911.

during the summer. *N. atlantica* was taken here in considerably greater numbers per half-hour haul than *N. microps*.

In the Mediterranean *N. atlantica* was taken in all areas investigated, except in the Sea of Marmara. In the Sidra Sea, however, it was not taken in the shallow area south of Sicily. The greatest numbers per half-hour were taken in the Balearic-Ionian-Adriatic Seas in the winter, and in the Balearic-Tyrrhenian Seas

**Table 14. *Nematoscelis atlantica* H. J. Hansen.**

Number per $^1/_2$ hour haul and frequency. Winter 1908—1909.

| Metres of wire | Cadiz Bay | Alboran Sea | Balearic Sea | Ligurian Sea | Tyrrhenian Sea | Ionian Sea | Adriatic Sea | Aegean Sea | Total |
|---|---|---|---|---|---|---|---|---|---|
| 25— 65 | 6 | 0 | 4 | 1 | 2 | 1 | 1 | 1 | 2 |
| 100—400 | 3 | 0 | 21 | 0 | 5 | 8 | 5 | 0 | 6 |
| > 500 | 10 | 2 | 13 | 0.3 | 5 | 34 | 14 | 0 | 11 |
| Total... | 7 | 2 | 16 | 0.3 | 4 | 22 | 8 | 1 | 8 |
| Frequency | 5/7 | 2/8 | 5/7 | 2/3 | 9/13 | 4/6 | 2/2 | 1/1 | 30/56 |

Summer 1910.

| Metres of wire | Cadiz Bay | Alboran Sea | Balearic Sea | Catalonian Sea | Ligurian Sea | Tyrrhenian Sea | Ionian Sea | Sidra Sea | Levant | Aegean Sea | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10— 65 | 16 | 11 | 7 | 0 | 5 | 12 | 2 | 0 | 0 | 0 | 9 |
| 100—400 | 100 | 6 | 54 | 0 | 10 | 24 | 6 | 4 | 1 | 2 | 38 |
| ≥ 500 | 50 | 6 | 47 | 10 | 5 | 33 | 9 | 7 | 8 | 1 | 23 |
| Total... | 63 | 7 | 39 | 10 | 7 | 22 | 8 | 5 | 6 | 1 | 25 |
| Frequency | 5/8 | 4/10 | 16/20 | 2/4 | 4/4 | 12/13 | 6/8 | 2/3 | 3/4 | 2/6 | 56/99 |

in the summer. The catches were, in some cases, many times larger in the summer than in the winter, both inside and outside of Gibraltar and for both species.

The vertical distribution of *N. atlantica* shows that, for the material regarded as a whole, the greatest numbers per half-hour haul were taken with more than 500 metres of wire during the winter. During the summer the greatest numbers were taken with 300 metres of wire, the numbers being somewhat less in the deeper hauls. In the summer *N. atlantica* was not taken in hauls with 25—65 metres of wire in the Sidra Sea, the Levant and the Aegean Sea, and in the Catalonian Sea it was only taken in deeper hauls than with 600 metres of wire. As a total 10 $^0/_0$ of the number per half-hour was taken in upper hauls during the winter and 15 $^0/_0$ during the summer. As the hauls were taken at night it is not surprising that *N. atlantica* was taken in the surface layer, even though we assume that it mainly belongs to the upper part of the intermediate layer, or depths from about 100 metres and more. Here it finds temperatures of about 13°—14° and a salinity of more than 38 $^0/_{00}$. That *N. atlantica* was not taken in upper hauls in the Ionian Sea, Sidra Sea and the Levant is due possibly to the circumstance that the warm surface layer attains both higher temperatures and a greater magnitude in this area during the summer than in any other area.

Table 15.

| Metres | St. 81 (15/6/1910) | St. 234 (10/9/1910) |
|---|---|---|
| 25 | 15°38 C. | 17°00 C. |
| 50 | 13°56 - | 14°18 - |
| 100 | 12°56 - | 13°73 - |
| 200 | 11°83 - | 12°59 - |
| 400 | 11°01 - | 11°36 - |
| 600 | 11°00 - | 11°60 |
| 800 | 11°25 - | 12°16 - |

We must assume that there is a certain difference in the demands of the two species in regard to temperature. The most obvious explanation of the fact that *N. microps* (judging by the present material) is not to be found in the Mediterranean seems to be that the temperatures of about 13°—14° at the depths at which the species mainly lives do not lie within its range of toleration. If we take this for granted and assume, as TATTERSALL (loc. cit.) has pointed out, that its maximum distribution is below a depth of 150—200 metres, it explains why *N. microps* is not transported inward through the Straits of Gibraltar with the surface water and does not inhabit the Mediterranean. Naturally a minor transportation can be presumed to take place and for this reason a few finds of this species inside Gibraltar, supporting the claims of COLOSI, may very well be possible. Otherwise I would call attention to the fact that it is only in the case of *T. gregaria* that we have been able to establish that such transportation takes place through the Straits of Gibraltar. Of the tropical and sub-tropical species which are found in Cadiz Bay it is only the surface forms which occur in the Mediterranean, and even in the case of these, judging by occurrence and frequency in the Alboran Sea, there seems to be little connection through the Straits. As *N. microps* and *N. atlantica* to a great extent have nearly the same distribution in the Atlantic Ocean, the difference in the range of tolerance in regard to temperature cannot be great, possibly a few of degrees, e. g. from 13° to 15° as the lower limit. The horizontal section of the distribution of temperature at 100 and 200 metres in the Atlantic (SCHOTT, 1912) shows, however, that precisely the isotherms for 13°—14° and 15° lie very close together and proceed approximately along the 40th degree of latitude in the north and the 35th in the south. A small clue in this matter is provided by the circumstance that ZIMMER (1914) found *N. atlantica* up to 35°10′ S. Lat., 2°23′ E. Long. whereas *N. microps* was only taken up 32°8′ S. Lat., 8°28′ W. Long. In our own material *N. atlantica* was taken off the coast of Portugal up to station 81 (41°32′ N. Lat.) and *N. microps* only to station 234 (38°10′ N. Lat.). In the same depths there is a certain difference between the temperatures at these two stations (vide Table 15).

At station 81, 1 individual of *N. atlantica* was taken with 300 metres of wire and at station 234, where both species were taken, there were many individuals (50 in all) of *N. atlantica* in hauls with 300 and 1000 metres of wire and 2 *N. microps* only in the last haul. If *N. microps* was taken here at the depth which the length of wire suggests, about 500 metres, the difference which is found in the temperature at the same depth at these two stations is of little significance to our problem. Otherwise the small catches of *N. microps* in Cadiz Bay suggest, especially during the winter, that the species has been taken here at one of its outposts.

Lebour (1926, II) has described larvæ of *N. microps* taken off Alexandria, but if my opinion of the distribution of the two species should prove to be correct, this must be *N. atlantica*. The larvæ in her material must have been spawned during the period January-March. In our material there are females of *N. atlantica* with eggs in the ovisac, taken at several stations, both in summer and winter, and in the majority of areas. The spawning time must, therefore, be very long, as in the case of *N. megalops*. Female *N. microps* with eggs were only found in Cadiz Bay in the summer of 1910.

### 20. **Nematobrachion boopis** Calman.

*Nematobrachion boopis* has a wide distribution in tropical and sub-tropical waters, but as it is a deep water form, it penetrates further north and south than species in the warmer surface layers. It has several times been taken south of Iceland in the Irminger Current as far north as 65° S. Lat. (Hansen, 1912) and on the Swedish Antarctic Expedition it was taken as far south as 48°27′ S. Lat. (Hansen, 1913).

In the present material *N. boopis* was taken in the area to the south west of Ireland and in the Bay of Biscay in 1905 and 1906, while in the 1908—1909 and 1910 material it was taken in the Atlantic Ocean from Cadiz Bay to the Bay of Biscay. In all it was taken at 2 stations in 1905, 14 stations in 1906, 9 stations in 1908—1909 and at 9 stations in 1910. It was everywhere taken in small numbers, on the average 10 per half hour haul for the whole of the material. The maximum number was 38 in a half-hour haul. Of a total of 48 positive hauls one was taken with 25 metres of wire, one with 65 metres, 7 with 300 metres and 39 hauls taken with 500 metres of wire or more down to 4350 metres of wire. 71 per cent of the number of individuals were taken in hauls with more than 500 metres of wire.

### 21. **Nematobrachion flexipes** Ortmann.

*Nematobrachion flexipes* has a wide distribution in tropical and sub-tropical waters in all oceans. In the Atlantic Ocean Zimmer (1914) found it between 35°10′ S. Lat. via the Equator to 17°28′ N. Lat. Tattersall (1926) found it in the tropical-oceanic area Chesapeake Bay—Bermudas—Florida with a maximum abundance between 50 and 200 metres. Its distribution thus agrees well with that of *E. gibboides* and other species which are found in tropical and sub-tropical waters.

In our material it was found in Cadiz Bay at 3 stations during the winter of 1908—1909 and at 4 stations in the summer of 1910. It was here taken in numbers of up to 60 per half-hour haul. In the Atlantic Ocean to the west of Spain and Portugal it was taken in small quantities at 3 stations in 1911. 55 $^0/_0$ of all individuals were taken with 25—65 metres of wire, 34 $^0/_0$ with 300 metres and 11 $^0/_0$ with 600—2000 metres.

### 22. **Stylocheiron carinatum** G. O. Sars.

*Stylocheiron carinatum* also has a wide distribution in tropical and sub-tropical waters (Tattersall, 1924). In the oceanic Bermudas—Florida area Tattersall (1926) found that as in the case of *N. flexipes* it was most common between 50 and 200 metres. In our material it was only taken in Cadiz Bay, at one station in 1909 and at two in 1910, altogether to a number of 7 individuals. One was taken with 25 metres of wire, four with 65 metres, one with 300 and one with 1200.

### 23. **Stylocheiron elongatum** G. O. Sars.

*Stylocheiron elongatum* is known from the tropical and sub-tropical Atlantic and from some localities in the Indian and Pacific Oceans (Hansen, 1912, 1915). Zimmer (1909) gives its distribution as northwards to the Irish coast, but I have not been able to confirm this from any literature available to me. The earlier localities known with certainty are all situated between about 36° N. and S. Lat. It is a characteristic deep water form. Tattersall (1926) found its maximum occurrence in the oceanic area Bermudas—Florida at between 400 and 700 metres. Curiously enough Sars' two type specimens were taken at the surface in the South Atlantic.

*S. elongatum* in our material was taken at 4 stations in Cadiz Bay in February 1909, and at one station there and one in the Bay of Setubal during the summer of 1910. The last mentioned locality, station 234, is the most northerly, namely 38°10′ N. Lat.

In all there were taken 384 individuals in the material, all in hauls with 600 metres of wire or more. On the average 13 individuals were taken per haul of half-an-hour's duration. The greatest number was taken at Station 66, 600 metres of wire, 2 hours, 244 individuals. The species must have been taken here in temperatures between 12° and 13°. If *S. elongatum* is found in waters northwards to the Irish coast on the east side of the Atlantic Ocean, it must thrive in temperatures down to 10° or less.

### 24. Stylocheiron longicorne G. O. Sars.

As mentioned in the systematical section all determinations of *S. longicorne* prior, in any case, to 1908 are uncertain because it was confused with *S. suhmii*. We have, nevertheless, a fairly clear understanding of the distribution of *S. longicorne*. Tattersall (1924) sums up our knowledge of *S. longicorne* by saying that it is "widely distributed in tropical and sub-tropical waters of the world". In the Atlantic Ocean it has been taken from about 63° N. Lat. south of Iceland to the waters south of the Cape of Good Hope (Hansen, 1908). In the oceanic area Chesapeake Bay—Bermudas—Florida Tattersall (1926) found that it had its maximum abundance between 200 and 500 metres. It has also previously been characterised, inter alia by Chun (1896), as a typical deep water form. From the Mediterranean *S. longicorne* was mentioned by Sars as early as 1885, but by subsequent authors it has to a great extent been confused with *S. suhmii*. It was last mentioned by Denis (1929) from Banyuls sur Mer.

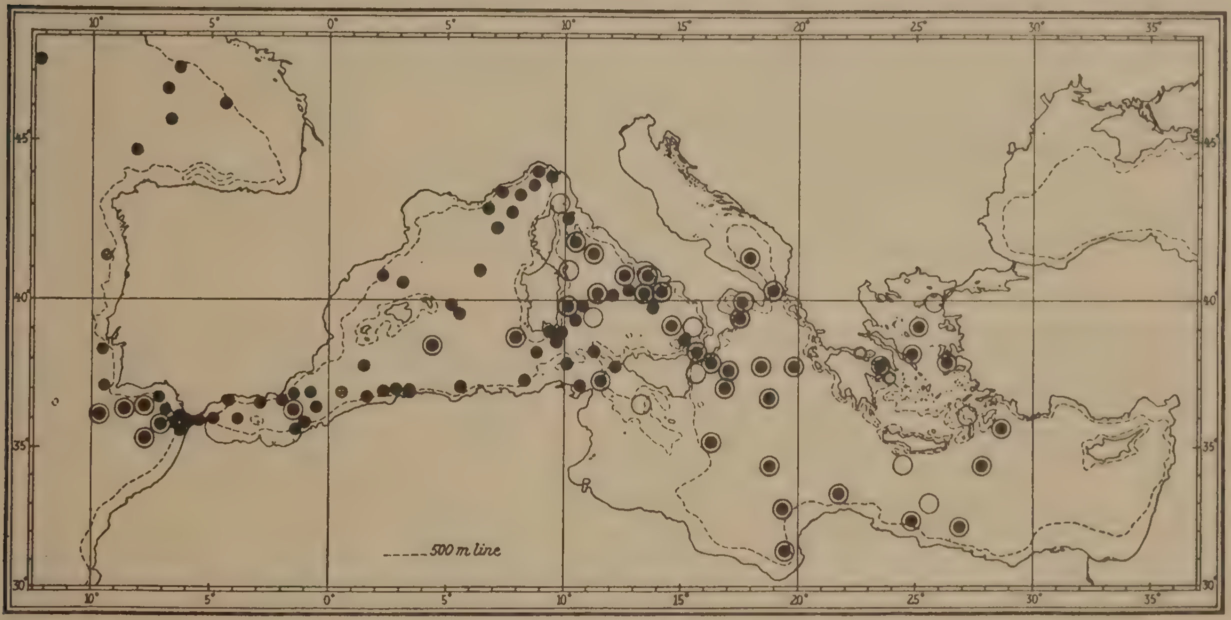

Fig. 17. ● *Stylocheiron longicorne*, ○ *Stylocheiron suhmii*, Positive stations 1906, 1908—09, 1910, 1911, 1912.

*Stylocheiron longicorne* was taken at, in all, 120 of the 222 positive stations from which we have material. In 1905 it was only taken at one station (St. 82) south west of Ireland. This is at the same time the most northerly locality at which it was taken in the present material, namely 51° N. Lat. In 1906 it was taken at a total of 11 stations in the same area, and in the Atlantic Ocean in 1911 it was taken at 2 stations. In the Mediterranean in 1908—1909, 1910 and 1911—1912 it was taken at the localities which the chart, Fig. 17, shows.

We shall mainly occupy ourselves below with the results of the expeditions of 1908—1909 and 1910.

In 1908—1909 *S. longicorne* was taken at 39 out of 56 stations, and in the summer of 1910 at 67 of 99 stations, in other words, with nearly the same frequency. Within the individual areas the frequency fluctuates somewhat in the manner shown by the accompanying table.

In the Atlantic and the Bay of Biscay *S. longicorne* was only taken at one station out of 7 in the winter and 5 of 15 in the summer. This low frequency is explained to some extent by the fact that a good many of the stations in these waters were taken in on the coastal bank where this oceanic deep water form cannot be common. The same explanation is applicable to certain waters in the Mediterranean Sea, such as the shallow part of the Sidra Sea.

Table 16. ***Stylocheiron longicorne*** **G. O. Sars.**

Number per 1/2 hour haul and frequency. Winter 1908—1909.

| Metres of wire | Atlantic | Cadiz Bay | Alboran Sea | Balearic Sea | Ligurian Sea | Tyrrhenian Sea | Ionian Sea | Adriatic Sea | Aegean Sea | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 10— 65 | 0 | 1 | 1 | 1 | 13 | 4 | 0 | 1 | 0.5 | 3 |
| 100—400 | 0 | 2 | 68 | 63 | 3 | 17 | 17 | 51 | 14 | 28 |
| ≥ 500 | 0.5 | 12 | 85 | 29 | 14 | 17 | 7 | 20 | 0 | 2 |
| Total... | 0.5 | 5 | 51 | 31 | 10 | 13 | 11 | 24 | 7 | 18 |
| Frequency | 1/7 | 6/7 | 7/8 | 6/7 | 3/3 | 9/13 | 4/6 | 2/2 | 1/1 | 39/56 |

Summer 1910.

| Metres of wire | Atlantic | Cadiz Bay | Alboran Sea | Balearic Sea | Catalonian Sea | Ligurian Sea | Tyrrhenian Sea | Ionian Sea | Sidra Sea | Levant | Aegean Sea | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10— 65 | 2 | 1 | 2 | 3 | 0 | 2 | 1 | 2 | 1 | 3 | 0 | 2 |
| 100—400 | 33 | 26 | 115 | 81 | 120 | 28 | 79 | 90 | 57 | 41 | 118 | 74 |
| ≥ 500 | 23 | 29 | 34 | 45 | 39 | 23 | 21 | 17 | 5 | 15 | 41 | 26 |
| Total... | 19 | 19 | 50 | 60 | 83 | 18 | 48 | 36 | 21 | 20 | 80 | 34 |
| Frequency | 5/15 | 6/8 | 7/10 | 16/20 | 2/4 | 4/4 | 9/13 | 8/8 | 2/3 | 4/4 | 4/6 | 67/99 |

During the winter of 1908—1909 *S. longicorne* was taken at all stations investigated in the Ligurian, Adriatic and Aegean Seas, and in the summer of 1910 at all stations in the Ligurian and Ionian Seas and the Levant, that is to say, precisely in the areas in which the stations lie in the open and deep sea. I think, therefore, we may safely conclude that *S. longicorne* is very common in open waters over the whole of the Mediterranean.

The table shows that the number per half-hour haul in the majority of areas in the Mediterranean is considerably greater than outside Gibraltar. During the winter of 1908—1909 the greatest number was taken in the Alboran-Balearic Seas and in the Adriatic Sea. In the summer of 1910 the greatest number was taken in the Catalonian-Balearic-Alboran Seas with a considerable number also in the Tyrrhenian Sea. In the eastern Mediterranean the greatest number was taken in the Aegean Sea. In the Ligurian Sea the number per half-hour haul was small both in summer and winter, while the Ionian Sea was not specially rich. The small number in the Tyrrhenian Sea in the winter can possibly be explained by the fact that the central part of this sea was badly investigated on this expedition as only station 24 was taken at any great distance from the coastal bank. This station, however, was not rich. In the Aegean Sea only one station was taken during the winter.

The vertical distribution of *S. longicorne* shows that the maximum number was taken in hauls with 100—400 metres of wire (mostly 300 metres) or deeper. Only an inconsiderable quantity was taken in the upper interval, and a very essential part of the hauls with 10—65 metres of wire was negative for this species. The main exceptions from this were a series of stations in the Ligurian and Tyrrhenian Seas in the winter of 1908—1909 where considerable numbers were taken in hauls with 25 and 65 metres of wire. We must thus draw the conclusion that *S. longicorne* mainly has its habitation at depths below 100 metres, and the majority of individuals were taken in the lower part of the surface layer or in the intermediate layer. As the hauls were chiefly made during the night and the animals were therefore in an upper position of their diurnal vertical migration, we must assume that it is particularly the movements in the intermediate layer which are of importance to the spread of this species, even if, without doubt, the movements of the surface layer also play a certain part at times.

In the same manner as other species which mainly belong to the intermediate layer *S. longicorne* occurs most abundantly in the Alboran and Catalonian Seas, precisely the areas in which the surface layer species are rare and, in some cases, entirely absent. In the eastern Mediterranean we must assume that its most important distribution area is the Adriatic—Ionian Seas and, in any event as far as the summer is concerned, the Aegean Sea. During the winter the Aegean Sea was not sufficiently investigated, but it is also possible that *S. longicorne* is rare in the Aegean Sea in winter on account of the special hydrographical conditions which exist there at this period of the year.

In its distribution *S. longicorne* is very much in accord with *E. krohnii* and *N. megalops*, but these two were also taken in the Sea of Marmara from which *S. longicorne* is entirely absent.

### 25. Stylocheiron suhmii G. O. Sars.

*Stylocheiron suhmii* has almost the same distribution as *S. longicorne*. Tattersall (1924) also says regarding this species that it is "widely distributed in tropical and sub-tropical waters of the world". In the oceanic area Chesapeake Bay—Bermudas—Florida Tattersall (1926) found *S. suhmii* and *S. longicorne* in most cases at the same stations. *S. suhmii* had a maximum abundance between 100 and 200 metres. Zimmer (1914) also found both species at the majority of stations in the Atlantic Ocean from 28°42′ N. Lat. and southwards via the Equator to 32°8′ S. Lat., but *S. longicorne* was also taken a little further south to 35°10′ S. Lat. We cannot form for ourselves from the literature any clear picture of the northern limit in the Atlantic Ocean, but *S. suhmii* hardly goes as far north as *S. longicorne*. Thus, in our material from 1905 and 1906, it was not taken from the area south-west and south of Ireland. In the Atlantic Ocean in 1911 it was taken at stations 376 and 377, the more northerly of these being at 34°41′ N. Lat. 16°14′ W. Long. Chart Fig. 17 shows the records in the material from 1908—1909 and 1910 and from stations in the Mediterranean in 1911—1912. In the Mediterranean *S. suhmii* has been taken several times with certainty (Colosi, 1922) and Lebour, (1926, II) has described its larvæ from the waters outside of Alexandria. *S. suhmii*, however, was not found off Naples by Zimmer (1915) nor off Banyuls sur Mer by Denis (1929).

In the 1908—1909 and 1910 material *S. suhmii* was not taken in the Atlantic Ocean outside Cadiz Bay, where it was taken at 2 stations out of 7 in the winter and 3 out of 8 in the summer.

In contrast to *S. longicorne*, *S. suhmii* has a limited distribution in the Mediterranean (vide Fig. 17). It is not found at all in material from the Ligurian and Catalonian Seas and, in addition, it is lacking in the Balearic and Aegean Seas in the winter and in the Alboran Sea during the summer. Similar to *S. longicorne* this species has not been taken in the Sea of Marmara. The frequency and number per half-hour haul in the other areas emerge from the accompanying table.

As the table shows, there is a striking difference between the eastern and western part of the Mediterranean. Apart from the one station in the Aegean Sea in the winter *S. suhmii* was taken at all stations in the eastern Mediterranean, east of Pantellaria Channel—Sicily—Messina, and the numbers to some extent were considerable, especially in the Aegean Sea during the summer. In the Western Mediterranean the frequency was high in the Tyrrhenian Sea in the winter, 10 out of 13 stations, but otherwise the frequency in the western basin was inconsiderable and also the number per half-hour haul. The frequency and number in Cadiz Bay were of the same order of magnitude as in the western Mediterranean. In the Alboran Sea only one individual was found, in a ring-trawl (Station 53, 18/2/1909, C. 200, 2600 metres of wire, 1 hour. 30 min.), and as this gear is closed before being hauled in, the specimen was taken at a depth of about 1000 metres. In the Balearic Sea one individual was taken at station 115, one at station 204 and 2 at station 138 (in the Pantellaria Channel). At all these stations in the Balearic Sea both higher and lower water layers were investigated without any resulting catch of *S. suhmii*.

According to the limits which Schmidt (1912) indicates between the various areas of sea, station 33 (22/1/1909) lies in the Ligurian Sea, but as the water masses here flow from the Tyrrhenian Sea to the Ligurian Sea, I assume that the shallow part between these two areas is populated from the Tyrrhenian Sea, and in this case I have therefore counted station 33 as belonging to the Tyrrhenian Sea. At this station 2 specimens of *S. suhmii* were taken. The investigation in the western Mediterranean embraces 56 stations in all. On the basis of the material, therefore, we can conclude with certainty that *S. suhmii* is rare west of the Straits of Messina and the Pantellaria Channel and only occurs scattered and in small numbers. In the Tyrrhenian Sea the frequency is thus considerable in the winter, but the numbers are small. The greatest catch was 15 specimens in a haul of one hour. The explanation of the much higher frequency in the Tyrrhenian Sea in the winter than in the summer might perhaps be the circumstance that 12 of the 13 winter stations were taken on the shelf and near to the shore, whereas only 7 of 13 stations had a similar situation in the summer as 6 stations were taken in the central and deep part of the Tyrrhenian Sea.

**Table 17. *Stylocheiron suhmii* G. O. Sars.**

Number per $^1/_2$ hour haul and frequency. Winter 1908—1909.

| Metres of wire | Cadiz Bay | Alboran Sea | Tyrrhenian Sea | Ionian Sea | Adriatic Sea | Total |
|---|---|---|---|---|---|---|
| 10— 65 | 4 | 0 | 1 | 58 | 4 | 20 |
| 100—400 | 5 | 0 | 2 | 8 | 1 | 7 |
| >500 | 0.5 | 0.3 | 0.5 | 4 | 0 | 2 |
| Total... | 3 | 0.3 | 1 | 27 | 2 | 10 |
| Frequency | 2/7 | 1/8 | 10/13 | 6/6 | 2/2 | 21/56 |

Summer 1910.

| Metres of wire | Cadiz Bay | Balearic Sea | Tyrrhenian Sea | Ionian Sea | Sidra Sea | Levant | Aegean Sea | Total |
|---|---|---|---|---|---|---|---|---|
| 10— 65 | 2 | 2 | 2 | 35 | 8 | 3 | 120 | 25 |
| 100—400 | 2 | 0 | 0 | 44 | 20 | 28 | 55 | 30 |
| >500 | 0 | 1 | 1 | 9 | 5 | 16 | 31 | 11 |
| Total... | 2 | 2 | 2 | 29 | 11 | 16 | 69 | 22 |
| Frequency | 3/8 | 3/20 | 3/13 | 8/8 | 3/3 | 4/4 | 6/6 | 30/99 |

If this explanation is to suffice it must assume that in the Tyrrhenian Sea *S. suhmii* occurs as a coastal or slope form. The results from the summer of 1910, however, seem to contest such a view, inasmuch as the three positive stations are all situated in the deepest part of the Tyrrhenian Sea, outside the isobath for 3000 metres. In other words, the situation of the stations does not appear to be able to provide an explanation of the unequal frequency; we must, indeed, take it for granted that *S. suhmii* occurs more frequently in the Tyrrhenian Sea in the winter than in the summer.

In the eastern Mediterranean *S. suhmii* was taken in the greatest numbers in the Ionian Sea in the winter and in the Aegean Sea—Ionian Sea in the summer.

It is perhaps doubtful whether the one negative station in the Aegean Sea can be appropriated for the view that *S. suhmii* does not occur in the Aegean Sea in the winter, even if a station taken at the same site in Aegina Bay during the summer was positive. We will return to this point later.

The table also supports the opinion that *S. suhmii* belongs to higher water layers than *S. longicorne*. In the material from the winter the greatest number was taken in hauls with 10—65 metres of wire and in the material from the summer of 1910 in hauls with 100—400 metres of wire. Only in the Aegean Sea was the greatest number also taken in the summer in hauls with 10—65 metres of wire, otherwise the species seems to have its habitation somewhat deeper at this season of the year than during the winter. However, only inconsiderable quantities were taken with more than 500 metres of wire.

We may, therefore, in conformity with TATTERSALL (1926) conclude that the main habitation of *S. suhmii* is above 200 metres and that it consequently belongs to the surface layer.

Even if these horizontal hauls with young fish trawls fish through upper-lying water layers during the hauling-in it may, nevertheless, be of some interest to look more closely at a couple of stations with a view to elucidating the circumstance that *S. suhmii* has a deeper distribution in the summer than in the winter. I have, therefore, chosen station 11 and station 186 which lie in the same area of the Ionian Sea and which were very rich in this species and were well investigated. (Vide Table 18).

**Table 18.**

| Metres of wire | Approximate depth | St. 11. Dec. 12th 1908 | St. 186. Aug. 17th—18th 1910 |
|---|---|---|---|
| | | Number per ½ hour haul | Number per ½ hour haul |
| 10 | 5 | .. | 6 |
| 25 | 12 | 138 | .. |
| 65 | 30 | 108 | 2 |
| 300 | 150 | 1 | 60 |
| 1000 | 500 | 2 | .. |
| 1200 | 600 | .. | 32 |
| Depth in metres | | Temperatures C° | Temperatures C° |
| 0 | .. | 16.60 | 24.00 |
| 25 | .. | 16.62 | 18.30 |
| 75 | .. | 16.62 | 14.50 |
| 100 | .. | 15.42 | 13.79 |
| 150 | .. | 14.45 | 14.02 |
| 500 | .. | 13.94 | .. |
| 600 | .. | .. | 13.73 |

At station 11, *S. suhmii* was found in the surface layer in a temperature between 18° and 17°, at station 186, on the other hand, it was in deeper layers in temperatures of about 14°. Even if the gear fished during hauling-in only an inconsiderable number was taken in the topmost 30 metres where the temperature reaches more than 18°. LEBOUR (1926, I and II) draws the conclusion from her material of larvæ from the Levant that *S. suhmii* must spawn at lower temperatures than 21°75 and before the 1st May. Her greatest number of larvæ was taken in substantially lower temperatures, viz., between 16°75 and 18°10 and during the period January—March. Spawning takes place, in other words, during the winter and in the first months of spring. It is, therefore, of some interest to look at typical temperature conditions in the different areas of the Mediterranean during the winter. (Vide Table 19).

I have quoted the temperatures at 50, 150 and 300 metres. Above 50 there is, in all areas, practically speaking, an isothermi. The table thus gives a survey of temperature conditions in the water layers in which *S. suhmii* normally occurs. In the western Mediterranean the temperature at the depths here in question is mainly below 14°, varying from 12.55 to 14.02. In the eastern Mediterranean the temperature is everywhere above 14°, up to 16.62 at these selected stations, except at the one station in the Aegean Sea where the temperature is under 13° below 150 metres. At this station *S. suhmii* accordingly is lacking.

It is clear that there must be certain milieu factors which determine the different distribution of *S. suhmii* in the eastern and western Mediterranean, and if the temperature can act as a representative for these factors we must assume that a temperature of 14° or slightly more is the lowest at which the species can reproduce.

*S. suhmii* carries its eggs until they are hatched, and it is therefore of no consequence if the surface temperature in certain parts of the western basin should rise above 14° at the time spawning and hatching takes place. We must, therefore, assume that no spawning of *S. suhmii* worthy of mention can take place in the western part of the Mediterranean, nor in the northern part of the Adriatic Sea and the Aegean Sea where the water layers, according to J. N. Nielsen's account (1912), cool to below 14° in the winter.

*S. suhmii* belongs mainly to the surface layer and will be spread with the movements of this water layer (vide Nielsen loc. cit.) from the spawning area in the Ionian Sea—Sidra Sea—Levant over the whole of the eastern Mediterranean. Larvæ hatched in the Levant in the spring will also be carried into the Aegean Sea and this may explain the great stock we found there in the material from the summer. Whether *S. suhmii* may be stationary in individual parts of the Aegean Sea we have no opportunity of deciding, but, as mentioned, we must presume that it cannot reproduce with success in the northern and western parts.

*S. suhmii* can also be found in the upper strata of the intermediate layer, and with this water layer the species can be transported into the Tyrrhenian Sea, and also further, if slowly, to the other areas in the western basin, Balearic and Alboran Seas. In the upper strata of the intermediate layer the temperature is between 13°8 and 14° and in the Pantellaria Channel this water layer stretches up to 150 metres below the surface. From the Pantellaria Channel the intermediate layer flows into the Tyrrhenian Sea where it sweeps to the right along the Italian coast bank. This provides the explanation of the greater frequency of *S. suhmii* in the Tyrrhenian Sea than in other areas and also why it is more frequent at stations along the Italian coast than in the open sea and along the coast of Sardinia. That *S. suhmii* is transported into the Tyrrhenian Sea with the intermediate layer explains also the greater frequency in the winter than in the summer, since the inflow of the intermediate layer to the Tyrrhenian Sea is strongest in the autumn (Nielsen loc. cit.). It is indeed possible that we must take into account that *S. suhmii* can reproduce with success in particular areas of the Tyrrhenian Sea and that the species is to that extent stationary there, but the frequent finds of *S. suhmii* in small numbers near Messina and Naples can be explained equally satisfactorily by a continued supply from the Ionian Sea. The two individuals which were taken furthest west, at station 115 in the central Balearic Sea and at station 53 in the Alboran Sea were both taken at a depth of about 1000 metres with 2000 and 2600 metres of wire, a fact which, in the case of this species which belongs to higher layers of water, is a sign that we are faced with a transport in which the species gradually wanes and disappears.

Table 19.

Temperatures in degrees C. — Winter 1908—1909.

| Depth in metres | Cadiz Bay | Alboran Sea | Balearic Sea | | Tyrrhenian Sea | Ionian Sea | Adriatic Sea | Aegean Sea |
|---|---|---|---|---|---|---|---|---|
| | St. 65 | St. 53 | North. St. 37 | South. St. 43 | St. 24 | St. 11 | St. 15 | St. 18 |
| 50 | 15.61 | 14.02 | 12.49 | 13.98 | 14.02 | 16.62 | 15.21 | 15.41 |
| 150 | 15.05 | 13.16 | 12.55 | 13.44 | 13.62 | 14.45 | 14.25 | 12.85 |
| 300 | 13.06 | 12.94 | 13.08 | 14.01 | 13.87 | 14.30 | 14.00 | — |

*S. suhmii* is also found, although in small numbers, in Cadiz Bay, but if from here it were transported with the surface water layer into the Alboran and Balearic Seas, we ought to expect more finds along the north coast of Africa in the same manner as we found *T. gregaria*.

The small number and negligible frequency of *S. suhmii* in Cadiz Bay suggests otherwise also that the species has its proper area of distribution in the sea further towards the west and south. If we take it for granted that *S. suhmii* is confined in its distribution to the water masses with temperatures above 14°, this also agrees with the fact that it is not taken to the north of Cadiz Bay in the Atlantic Ocean.

The difference in the vertical distributions of the two allied species *S. longicorne* and *S. suhmii* has previously been established, but from the literature the impression is gained that their horizontal distribution is practically the same. The present material has enabled us to establish a substantial difference in the demands of these two species in regard to temperature, inasmuch as *S. suhmii* is hardly stationary in temperatures below 14° whereas *S. longicorne*, according to the most northerly and most southerly certain finds, is probably to be found in water masses with temperatures down to 10° or slightly less. The conditions in regard to *S. longicorne* in the Mediterranean suggest that its requirements in the matter of temperature agree broadly with those we have found for *E. krohnii* and *N. megalops*, namely, with a lower limit of about 8°—10° and an upper limit of about 17°—18°. It is possible, however, that *S. longicorne* tolerates somewhat higher temperatures, but such an assumption is not necessary in order to explain the horizontal distribution of this deep water form throughout the whole of the tropical Atlantic Ocean.

If we take 10° as a lower temperature limit for *S. longicorne* and 14° for *S. suhmii*, the two species will, nevertheless, have practically the same northern limit in the western Atlantic Ocean where these isotherms at 100—400 metres deep lie close together near the 40th degree of latitude, but in the eastern Atlantic *S. suhmii* will not go further north than to Cadiz Bay whereas *S. longicorne* will find suitable temperature conditions northwards to about 60° N. Lat., south of Ireland. In these waters it has actually been taken up to about 63° N. Lat. at a depth of 100 metres, but I have no knowledge of the temperature conditions under which the catch was made. In the southern Atlantic the isotherms for 14° and 10° at 100 metres run parallel and fairly near together between about 35° and 40° S. Lat., which agrees well with the most southerly finds of both species hitherto known.

### 26. Stylocheiron maximum H. J. Hansen.

*Stylocheiron maximum* has a wide distribution in all oceans and in the Atlantic it was taken from 61°49′ N. Lat. west of the Faroes to 49°56′ S. Lat. (Hansen 1915). It is a characteristic deep water form. Tattersall (1926) is of opinion that in his material from the area Chesapeake Bay—Bermudas—Florida it was not taken above 200 metres. *S. maximum* was determined for the first time with certainty from the Mediterranean by Zimmer (1915) who found it in material taken near Naples. It has, however, undoubtedly also been taken there earlier, for Tattersall (1909) mentioned that Lo Bianco found an elongate leg 27 mm. long which he ascribed to *S. chelifer* (syn. *S. abbreviatum*) and he estimated the length of the animal to be about 40 mm. Even if this calculation of the length cannot be correct, because, as Tattersall remarks, the animal and the elongate legs do not grow proportionately, the animal must certainly have been so large that we must take it for granted that the leg has belonged to a specimen of *S. maximum*. In the present material I have found *S. maximum* of up to a total length of 32 mm. Denis (1929) has *S. maximum* from waters off Banyuls sur Mer.

In our material *S. maximum* was taken at 1 station to the south west of Ireland in 1905, and at 14 stations in the same area and in the Bay of Biscay in 1906. Everywhere it was taken in small numbers, and none were taken with less than 300 metres of wire. *S. maximum* was not taken at stations in the Atlantic Ocean in 1911, no doubt because all hauls were taken near the surface. (Max. 47 metres of wire).

In the material from 1908—1909 and 1910 *S. maximum* was taken in all investigated areas except in the Sea of Marmara, vide Chart, Fig. 18. It was taken at 24 out of 56 stations in the winter and 42 of 99 in the summer. In all cases the specimens taken were few in number, the maximum being 19 in a half-hour haul in Cadiz Bay and in the Tyrrhenian Sea during the summer of 1910. The numbers otherwise were so small that it is of little or no interest to calculate the averages per half-hour haul in the various areas. For the material as a whole 2 individuals per half-hour were taken in the winter of 1908—1909 and 5 per half-hour in 1910. The greatest catches per half-hour were made in the Atlantic and the Tyrrhenian—Ionian Seas in the winter, and in the Atlantic, Balearic—Ligurian—Tyrrhenian—Aegean Seas during the summer.

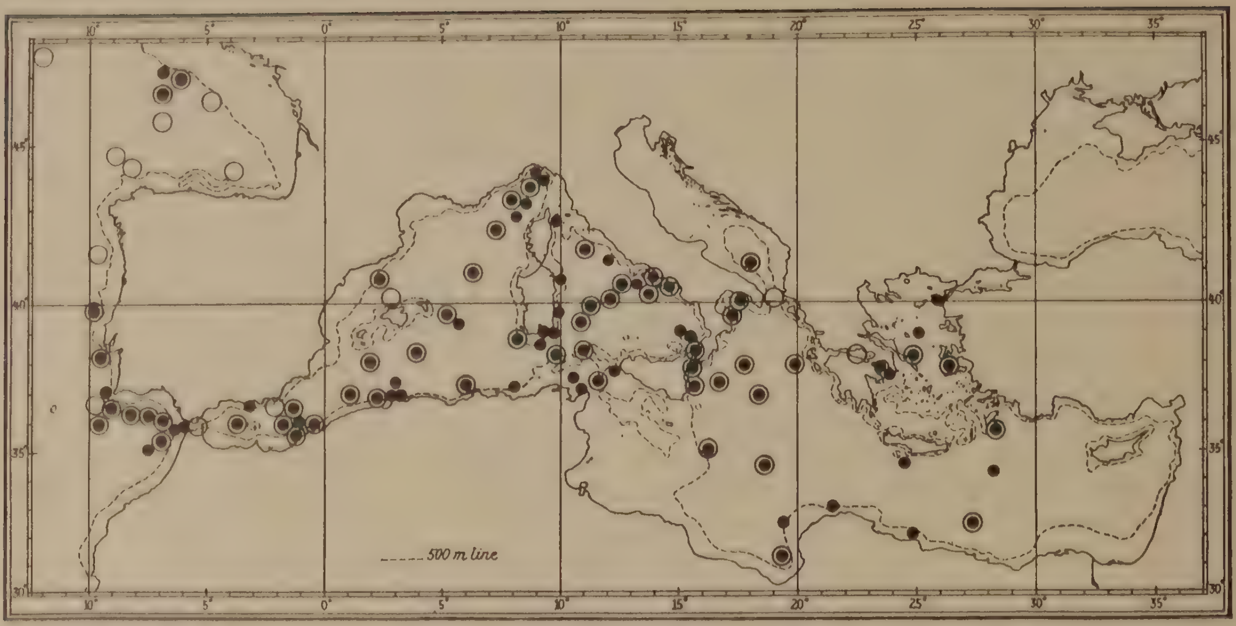

Fig. 18. ● *Stylocheiron abbreviatum*, ○ *Stylocheiron maximum*. Positive stations 1906, 1908—09, 1910, 1911, 1912.

In the material from the winter one individual was taken with 25 metres of wire at station 11 in the Ionian Sea and one individual with 65 metres of wire at station 14 in the Adriatic Sea, but otherwise *S. maximum* was not taken in hauls with less than 200 metres of wire. In the interval 200—400 metres of wire 116 specimens in all of *S. maximum* were taken. In the interval below 500 metres of wire 315 individuals in all were taken. As the deep hauls are of much greater duration, the number per half-hour is about the same, namely, about 3, but the frequency in the deepest stage, however, is so much the greater; there are many more negative hauls in the interval 200—400 metres of wire. With the small numbers we have at our disposal we can, nevertheless, draw the conclusion that *S. maximum* almost exclusively has been taken at depths below 100 metres (200 metres of wire) and most commonly below 200 metres (400 metres of wire).

### 27. **Stylocheiron abbreviatum** G. O. Sars.

*Stylocheiron abbreviatum* has approximately the same distribution as *S. longicorne*, but it is difficult to obtain any detailed and accurate understanding of the distribution inasmuch as prior to 1908 the species included *S. maximum*. *S. abbreviatum* is known from tropical and sub-tropical waters in all the oceans, and in the Atlantic Ocean it has been taken from about 35° S. Lat. via equatorial waters up to near the coast of Ireland (ZIMMER 1909, 1914). In the same manner as *S. maximum* and *S. longicorne* it is a deep water form with a maximum abundance between 100 and 500 metres (TATTERSALL, 1926). From the Mediterranean it is known, also in older literature, where, however, it must be presumed also to embrace *S. maximum*. Thus it is mentioned by TATTERSALL (1909), COLOSI (1916, 1917, 1920) and by DENIS (1929). LEBOUR (1926, II) has described its larvæ taken in the waters off Alexandria.

*S. abbreviatum* in our material was not taken in 1905, but at 2 stations in 1906, station 76, south-west of Ireland, and station 190 in the Bay of Biscay, near the continental shelf off Brittany. It was also taken at 2 stations in the Atlantic in 1911.

In the material from 1908—1909 and 1910 it was taken in all investigated areas in the Mediterranean except in the Sea of Marmara, and in contrast to *S. maximum* also in Aegina Bay during the winter. In all it was taken at 33 of 56 stations in 1908—1909 and at 50 of 99 stations in 1910, in other words with somewhat more frequency than *S. maximum*. Chart, Fig. 18 shows the distribution according to this material. To some extent *S. abbreviatum* was taken in considerable numbers in the Mediterranean, up to 253 individuals per half-hour haul (Station 132, Tyrrhenian Sea, 1910). For this species, therefore, I have calculated the number per half-hour haul in the various areas, as shown by the following table.

*S. abbreviatum* was taken at station 76 in 1909 and station 24 in 1910, both situated near the edge of the continental shelf in the Bay of Biscay. Otherwise it is rare in the Atlantic north of Cadiz Bay. Here it was taken in comparatively large numbers per half-hour and at 5 of 7 stations in the winter and 7 of 8 in the summer. In the Alboran Sea the frequency was lower, and likewise it was small in the summer in the Catalonian Sea and only 2 of 4 in the Adriatic in the winter. The frequency was considerable in the other areas investigated. It was taken at all stations in the Ligurian Sea and the Levant in the summer of 1910. The number per half-hour haul was greatest in the Balearic Sea in the winter. In the summer of 1910 there was also a large number per half-hour in the Balearic Sea, but considerably greater numbers were taken in the Tyrrhenian and Sidra Seas and also in the Ionian Sea, the Levant and the Aegean Sea. *S. abbreviatum* occurs most commonly in the southern and eastern areas of the Mediterranean, the southern Balearic, the Tyrrhenian, the Sidra Sea and the Levant. It occurs, however, in such large numbers and with such great frequency in the western and northern Mediterranean that it certainly is also stationary in that area. It has an occurrence in the Mediterranean which does not entirely coincide with that of any other species.

### Table 20. *Stylocheiron abbreviatum* G. O. Sars.

Number per $^1/_2$ hour haul and frequency. Winter 1908—1909.

| Metres of wire | Atlantic | Cadiz Bay | Alboran Sea | Balearic Sea | Ligurian Sea | Tyrrhenian Sea | Ionian Sea | Adriatic Sea | Aegean Sea | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 10—65 | 0.5 | 3 | 0 | 0 | 1 | [illegible] | 3 | 0 | 0 | 3 |
| 100—400 | 0 | 6 | 9 | 54 | 0.3 | 18 | 11 | 8 | 4 | 16 |
| ≥ 500 | 0.3 | 3 | 2 | 10 | 0.1 | 0 | 1 | 0 | 0 | 1 |
| Total | 0.3 | 4 | 6 | 10 | [illegible] | [illegible] | [illegible] | 1 | 1 | 5 |
| Frequency | 2/7 | 5/7 | 3/8 | 5/7 | 2/3 | 10/18 | 4/6 | 1/2 | 1/1 | 33/60 |

Summer 1910.

| Metres of wire | Atlantic | Cadiz Bay | Alboran Sea | Balearic Sea | Catalonian Sea | Ligurian Sea | Tyrrhenian Sea | Ionian Sea | Sidra Sea | Levant | Aegean Sea | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10—65 | 0 | 3 | 0 | 0 | 0 | 1 | 2 | 1 | 0 | 0 | [illegible] | 1 |
| 100—400 | 4 | 38 | 7 | 28 | 0 | 11 | 104 | 81 | 82 | 78 | 68 | 54 |
| ≥ 500 | 12 | 12 | 0.5 | 23 | 13 | 5 | 84 | 17 | 6 | 28 | 86 | 29 |
| Total | 8 | 21 | 1 | [illegible] | [illegible] | 7 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Frequency | 3/15 | 7/8 | 4/10 | 16/20 | 1/4 | 4/4 | 9/18 | 6/8 | 2/3 | 4/4 | 5/6 | 60/99 |

In the summer of 1910 particularly, *S. abbreviatum* occurred scantily in the uppermost hauls with 10—65 metres of wire, and both in the summer and winter there was an outstanding maximum of the occurrence in hauls with 100—400 metres of wire. *S. abbreviatum* was, therefore, substantially taken in water masses with a temperature of approximately 13°—16° C. The rare occurrence in the western and northerly areas of the Mediterranean, suggests that the lower temperatures lie near the lower limit of the temperature requirements of the species. Its distribution in the Atlantic Ocean, in so far as we know it, also suggests that a temperature of about 12° or 13° forms the limit for the distribution of the species towards the north and south.

**Lebour** (1926, 1) found *furcilia* and *cyrtopia* stages of *S. abbreviatum* off Alexandria during the period January 23 to May 1. In our material a female was taken with almost hatched nauplii in the ovisac at station 68 on 27/2/1909 in Cadiz Bay. At stations 281, 282 and 283 on 1/3, 8/3 and 12/3/1911 in the Straits of Messina there were many juveniles of this species from *cyrtopia* stages and upwards. These data confirm that spawning takes place in the Mediterranean and outside during the first months of the year, but we are unable to make any statement regarding the duration of the spawning period.

# IV. DISCUSSION.

In his review of the geographical distribution of the euphausiids **Zimmer** (1927) states: "Alles in allem können wir für die Euphausiaceen nur 3 tiergeographische Regionen unterscheiden, die nördliche kalte, die südliche kalte Zone und die warmen Meere. Dazwischen schieben sich Übergangsgebiete ein." One can agree with the main features of this view if one considers the sea to be built up, in hydrographical respects, of three components, Arctic, Antarctic and tropical waters. The areas between cold and warm waters, (**Zimmer** gives no temperature limits for these designations), however, are not transition areas, merely filled with mixed layers of polar and tropical origin, with gradual transitions from cold to warm water, but are filled with well defined water masses having specific physical qualities and separated towards cold and warm waters with convergence lines and discontinuity layers. In the south Atlantic Ocean **Deacon** (1933) distinguishes between 4 components as far as the uppermost water layers are concerned, namely, Antarctic, sub-Antarctic, sub-tropical and tropical waters. In addition to these there are the deep layers of various origins, Antarctic intermediate water, warm deep water and Antarctic deep water. This classification agrees in its main features with the views of **Wüst** and other hydrographers (**Wüst** 1928). The surface temperatures in these water masses vary with the seasons, and the limits between them, therefore, agree, all according to the season of the year, with various surface isotherms. The Antarctic convergence ("The Polar Front") falls between the isotherms for 1° to 3°, the sub-tropical convergence coincides with the isotherms from 11° to 14°. **Rustad** (1930), who has discussed the occurrence of Antarctic euphausiids with a view to zoo-geographical classification, estimated that the surface isotherm for 12° formed the boundary for the sub-Antarctic region to the north and that the isotherm for 1° formed the boundary towards the Antarctic region. Subsequently **Mackintosh** (1934) has been able to establish that these convergence lines form important boundaries for various plankton communities.

In the northern Atlantic Ocean the Arctic and sub-Arctic waters are unimportant formations compared with the corresponding extensive layers in the south. The area with a temperature between about 3° and 11°—14° in the surface, corresponding to sub-Antarctic waters in the south, is, in the north Atlantic, mainly filled with water of a greater salinity of north Atlantic sub-tropical origin, and this water also fills the deeper layers of the north Atlantic and contributes to the formation of the warm deep water.

This water in the surface layer is most often called temperate Atlantic water and in faunistic respects it forms the transition area for arctic-boreal and tropical-sub-tropical species. To this extent it might seem justifiable to adopt **Zimmer's** point of view that we can only reckon with cold water and warm water areas with an area of transition, but an exhaustive analysis of the euphausiid fauna shows that also in the north Atlantic it is natural to reckon with one or more fauna communities characteristic of the transition layers.

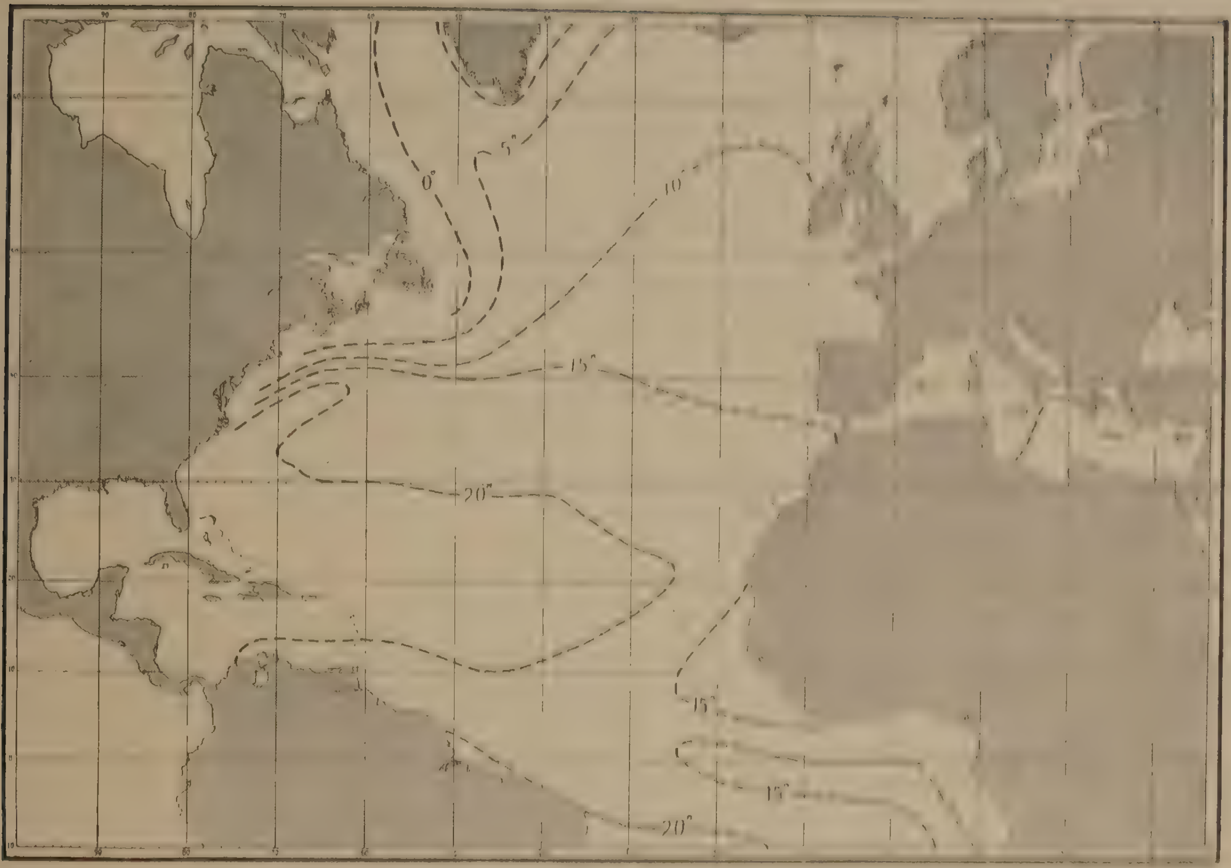

Fig. 19. Mean annual isotherms 100 metres below surface, after SCHOTT (1912).

The 27 species of euphausiids which are to be found in our material can, therefore, according to their horizontal and vertical distribution, be divided into the following fauna communities:

## A. Surface species. Maximum abundance between surface and 200 metres

1. Arctic-boreal species. Distributed north of the isotherm for 10°–12° at a depth of 100 metres.

There are only three Arctic-boreal euphausiids, *Thysanoessa raschi*, *Thysanoessa inermis* and *Thysanoessa longicaudata*. Only the last two species are taken in our material, and only in the area south west of Ireland, where KRAMP (1913) has previously proved that they have their southern limit. These waters have also been proved for other groups of animals to be the most southerly area for the distribution of Arctic-boreal species. HJORT (1912) has thus pointed out that our most important Arctic-boreal cod fishes have their southern limit there and has called attention to the fact that the limit coincided with the isotherm for 10°–12° at a depth of 100 metres.

2. Atlantic-boreal species. Common distribution north of the isotherm for 15° at a depth of 100 metres.

As belonging to this group I count *Meganyctiphanes norvegica* and *Nyctiphanes couchii* although there are substantial differences in their distribution which first and foremost, however, are due to the circumstance that *N. couchii* is confined to the coast banks, whereas *M. norvegica* has also a more oceanic distribution

Zimmer (1927) counts *M. norvegica* as a cold water form and *N. couchii* as characteristic of the transition area. *M. norvegica* has been taken right in the Polar Sea, but is found in the most northerly localities common only in water of Atlantic origin. *N. couchii* has been taken in coastal waters as far north as about 63°, off the coast of Norway. To the south the limit of the distribution of both species coincides better as their common occurrence in the Atlantic goes to Cadiz Bay. Both are also to be found in the Mediterranean, but in considerably smaller numbers than outside, *M. norvegica* more frequently than *N. couchii*. Where the cold water from Cadiz Bay penetrates southward along the west coast of Africa *N. couchii* is taken as far south as to Cape Blanco, and so far south the mean annual surface isotherm for 20° is also shifted. As mentioned in the reference to *M. norvegica* Bigelow assumed that it has a range of tolerance in regard to temperature up to 19°5, but hitherto it has not been taken south of Cadiz Bay.

3. Temperate-Atlantic species. Common distribution in the water masses within the isotherms for 9° and 19° at a depth of 100 metres.

As a distinct fauna-element characteristic for these water masses I have combined:—

*Euphausia krohnii* which is north Atlantic, possibly bi-polar.
*Nematoscelis megalops* which is bi-polar Atlantic.
*Stylocheiron longicorne* which has a wide distribution in all oceans.

The difference which lies in their horizontal distributions is a consequence of their different vertical distributions. *Euphausia krohnii* is found with a maximum abundance above 200 metres, but can also occasionally be taken in considerable numbers at greater depths. *Nematoscelis megalops* and *Stylocheiron longicorne* are both rare near the surface and have a maximum abundance below a depth of 100 metres, in some waters considerably deeper.

In his investigation of the material from the "Bache" collected in the Chesapeake Bay—Bermudas—Florida area Tattersall (1926) arrived at the result that *E. krohnii* and *N. megalops* must be regarded as "northern or boreal species" whereas he found *S. longicorne* in deep waters (max. abundance below 200 metres) in the tropical oceanic area. We can understand this interpretation by the special hydrographical conditions which exist in this part of the Atlantic Ocean. Off the east coast of America water masses of temperatures of, say, 5° to 20° are confined to a small wedge between the cold water from the north and the warmer Atlantic water outside. Hjort (1912) has used the expression that these transition layers are here "squeezed" between the other water masses, whereas the isotherms towards the European side spread themselves in a fan-shaped manner so that the temperate transition layers here embrace the tract from the south coast of Iceland to Cadiz Bay. Off the east coast of America, therefore, any temperate-Atlantic fauna element which may occur has no possibility of manifesting itself as such, the species will be found in conjunction with Arctic-boreal species from the north or tropical-sub-tropical species from the south, or the species will find temperatures answering to their requirements in deeper layers under the warmer surface water. On the European side where a temperate Atlantic fauna has its greatest geographical distribution, its boundaries, on the other hand, towards the most southerly and northerly fauna communities will not emerge so boldly, because these communities, all according to the range of tolerance of the species in regard to temperatures, will mix more with each other. The boundary towards the north for *E. krohnii*, *N. megalops* and *S. longicorne* coincides well with the isotherm for 9° at a depth of 100 metres, inasmuch as all three are taken up to about 63° N. Lat. south of Iceland. Their common occurrence does not include the Norwegian Sea, even though scattered finds of *E. krohnii* have been made up to about 63° N. Lat., on the west coast of Norway and of *N. megalops* right in the Barents Sea (Kramp, 1913). The occurrence of *E. krohnii* in the south Atlantic has not been verified in recent times, but in the north Atlantic its occurrence south to about 36° N. Lat. is certain. *N. megalops* has not been taken between 28° N. Lat. and 35° S. Lat. in the Atlantic Ocean where it goes to about 40° south. Zimmer (1917), however, is of opinion that this bi-polarity is, perhaps, only an apparent one on account of defective observations in deeper layers in the tropical area. *S. longicorne* has been taken continuously in deeper layers from about 63° N. Lat. to about 40° S. Lat.

All three species of this temperate-Atlantic element are found in the Mediterranean and my reason for holding that *S. longicorne* in the Atlantic undoubtedly must be counted as belonging to this fauna community in spite of its wider distribution, is that precisely this species by its manner of distribution in the Mediterranean is absolutely in accordance with *E. krohnii* and *N. megalops*, while at the same time these three deviate in their distribution entirely from all other species.

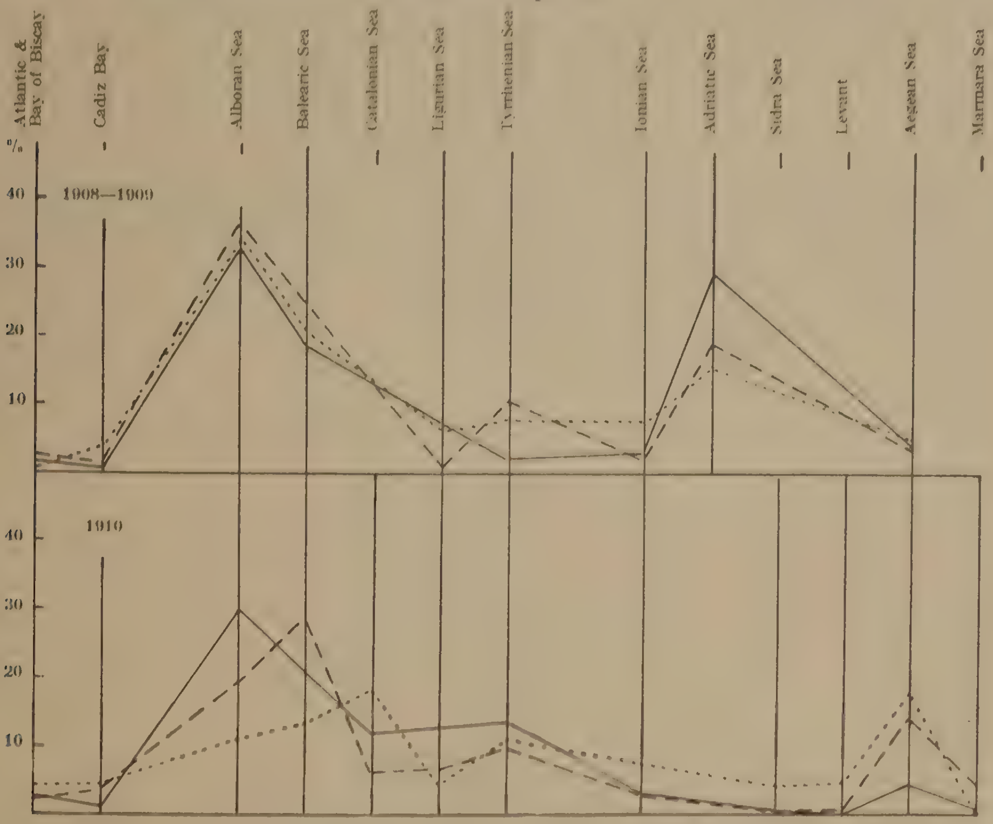

Fig. 20. The relative number per haul in the different areas.
——— *Nematoscelis megalops*, — — — *Euphausia krohnii*, ......... *Stylocheiron longicorne*.

I have previously expressed certain doubts about the method of procedure which I have pursued in the study of the distribution of the various species in the Mediterranean, namely, in regard to the calculation of the average number per half-hour haul in the different areas. When I add up these figures for all areas, however, and calculate the occurrence within the individual areas in per cent of the total, in other words, the relative number per half-hour expressed in percentage, vide Table III in the Appendices, I obtain for the species belonging to the same fauna community in the Atlantic Ocean such a good agreement in respect of the distribution, that I consider this as the best proof that my method of procedure yields serviceable results.

In Fig. 20 I have given a graphic statement of the relative number per haul of *E. krohnii*, *N. megalops* and *S. longicorne* in the various areas in the materials from the winter of 1908—1909 and the summer of 1910. As will be seen the agreement is so good that I have already expressed the opinion that we must consider this distribution as characteristic for this fauna community.

In the winter of 1908—1909 all three species had a maximum in the Alboran Sea and a secondary maximum in the Adriatic Sea. In the summer of 1910 all of them also had a maximum in the western part of the Mediterranean, but with a slight difference, however, inasmuch as the maximum of *N. megalops* was in the Alboran Sea whereas *E. krohnii* and *S. longicorne* with a considerable number at the same place had their maxima displaced to the Balearic and Catalonian Seas. All three had in the eastern Mediterranean a small secondary maximum in the Aegean Sea.

4. Sub-tropical species. These species are limited to the north and south by the isotherms for 11°—12° or 13° at a depth of 100 metres and all are found in the Mediterranean. The species are:—

   *Thysanopoda aequalis,*
   *Euphausia brevis,*
   *Euphausia hemigibba.*
   *Stylocheiron suhmii,*
   *Nematoscelis atlantica.*

The first four of these are found in tropical-sub-tropical waters in all oceans, whereas *N. atlantica* is not hitherto known outside the Atlantic Ocean. In the next place the first three are rare in tropical waters in the Atlantic as they are not taken in a belt near the Equator.

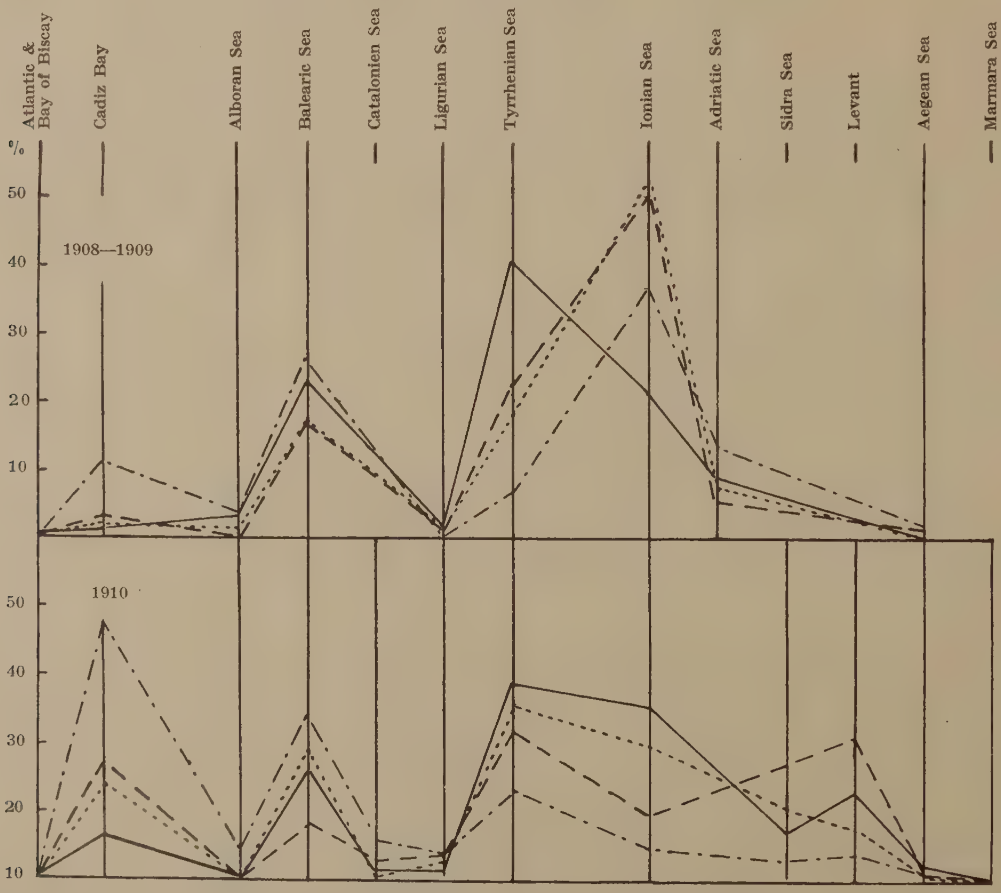

Fig. 21. The relative number per haul in the different areas.
———— *Thysanopoda aequalis,* — — — — *Euphausia brevis,* ········· *Euphausia hemigibba,* —·—·—· *Nematoscelis atlantica.*

For such species Bruun (1935, pp. 99—100) has introduced the term "bitropical" by which he means "species with two principal centres of distribution, round each of the tropical circles . . .; such species have a minimum of frequency in the equatorial zone or normally do not occur there at all; they have thus a discontinuous distribution."

*T. aequalis*, *E. brevis* and *E. hemigibba* should thus possibly be described as bitropical species.

These three have also been taken furthest north in the Atlantic Ocean, namely, up to the waters south-west of Ireland, but not north of the isotherm for 11°—12° at a depth of 100 meters. Judged by its occurrence in the Mediterranean *Stylocheiron suhmii* requires a somewhat higher temperature than the other species. It seems in the Atlantic to be limited by the isotherm for 13° or 14° at a depth of 100 metres.

*Nematoscelis atlantica* has a slightly deeper vertical distribution than the other species, namely, a maximum abundance below 100 metres. It, therefore, deviates also slightly from the others in its occurrence in the Mediterranean. Fig. 21 shows the relative number for four of these species in the various areas in 1908—1909 and 1910, taken from Table III. It will be observed that the agreement between *T. aequalis*, *E. brevis* and *E. hemmigibba* is striking and that it is also good in the case of *N. atlantica*. As Table III shows, *S. suhmii* deviates markedly, owing to its scanty occurrence in the western Mediterranean.

Common to all these species is an outstanding minimum in the Alboran, Catalonian and Ligurian Seas, whereby they stand apart from the species in the preceding community. All of them, with the exception of *S. suhmii* have a maximum number in the Balearic and Tyrrhenian Seas, and in the eastern Mediterranean in the Ionian Sea; in the summer material also in the south easterly areas. In contrast to the temperate-Atlantic species the relative number in the Adriatic Sea is inconsiderable.

All these species have been taken in the South Atlantic to between 32° and 36° S. Lat. a limit which agrees well with the site of the sub-tropical convergence.

5. Tropical species. Limited in the north and south by the isotherm for 15° at a depth of 100 metres. None of these species enter the Mediterranean, and in our material they were not taken north of Cadiz Bay.

*Thysanopoda obtusifrons*,
*Thysanopoda pectinata*,
*Euphausia gibboides*,
*Nematoscelis microps*,
*Nematobrachion flexipes*,
*Stylocheiron carinatum*.

It may perhaps be objected that I include the two *Thysanopoda* species and *N. microps* in this group "A" which should apply to species with a maximum abundance above 200 metres, as these three are generally regarded as deep water forms. All three have possibly their maximum abundance below 150 or 200 metres. They are, however, often taken at or near the surface, to some extent in considerable numbers. The two *Thysanopoda* species are, otherwise, so rare that our knowledge of them is slight.

It may seem unnatural that I do not regard the sub-tropical and tropical species as belonging to a single tropical-sub-tropical element, and there is also much in favour of doing so. In the south Atlantic and north-west Atlantic the isotherms for 11°—15° lie so close that the boundaries for the two communities practically coincide. It is only off the coast of Europe where these isotherms are separated from one another over a great distance that an accurate analysis of the temperature requirements of the individual species can permit us to separate sub-tropical and tropical species. In addition, I consider it as the best character whether the species enter the Mediterranean or not.

I cannot give any other explanation of the fact that some of the species which are taken in upper water layers of Cadiz Bay do not enter the Mediterranean than that the physical conditions in the Mediterranean, probably the temperature, do not fall within the range of tolerance of these species.

Of the 27 species of euphausiids which were taken in the material there remain 9 which have not been placed in any of these 5 fauna communities. These 9 species are all definite deep sea forms with a maximum abundance under a depth of 200 metres, even though some of them have often also been taken in higher water layers.

### B. Deep-sea species, maximum abundance below 200 metres.

These 9 species fall, according to the knowledge we have of them, into two groups:

1. North-Atlantic deep-sea species:

*Thysanopoda acutifrons.*
*Thysanopoda microphthalma.*

*T. acutifrons* is known from Cadiz Bay and northwards to 66° N. Lat. in Davis Strait, while *T. micropthalma* is not taken further north than to the west coast of Ireland. *T. acutifrons* has its maximum abundance below 400 metres. Young individuals of *T. microphthalma* have also been taken above 200 metres, but fully-grown individuals only in deeper hauls (Tattersall, 1926). Otherwise little can be said of these comparatively unknown species.

2. Tropical and sub-tropical deep-sea species:

*Bentheuphausia amblyops.*
*Nematoscelis tenella.*
*Nematobrachion boopis.*
*Stylocheiron elongatum.*
*Stylocheiron abbreviatum.*
*Stylocheiron maximum.*
*Thysanoessa gregaria.*

Zimmer (1927) regards *T. gregaria* as bi-polar, and it is, in any event, rare in tropical waters. The other species are also taken in deep water in tropical areas. The most northerly and southerly finds in the Atlantic Ocean are all situated between about 40° and 62° N. Lat. and 35° and 48° S. Lat. But these deep-sea species can scarcely be said to constitute a uniform community.

*S. elongatum* and *N. tenella* are not known north of about 40° N. Lat. and south of about 35° S. Lat. in the Atlantic, whereas *N. boopis* and *S. maximum* have been taken as far north as 62° N. Lat. and south to about 50° S. Lat. It is probable that all these species have their common distribution in various strata of the deeper water layers comprising water masses with temperatures from 15°–16° down to 2°–3°.

Of these deep-water species only *S. abbreviatum*, *S. maximum* and *T. gregaria* are taken in the Mediterranean, and the last-mentioned is, as frequently remarked, not stationary. As far as we know these three species are those of the deep-water forms which go nearest the surface, inasmuch as they are all frequently taken in the uppermost layers (above 30 metres) during the night and to some extent in considerable numbers. The other species are all more characteristic deep-water forms, in part possibly calling for fairly high or low temperatures above or below the uniform temperatures of about 13°–14° which exist in the deeper water layers in the Mediterranean. These species, therefore, are, so to speak, filtered at the Straits of Gibraltar where only the comparatively thin surface layer flows in.

*S. maximum* was taken in such scanty numbers in the Mediterranean that it is difficult to find anything characteristic in its occurrence there. *S. abbreviatum* was taken in considerably greater quantities, and for this species, therefore, I have calculated the relative number in the various areas, Fig. 22. In the winter of 1908—1909 this species had an outstanding maximum in the Balearic Sea and in the summer of 1910 smaller maxima in the Tyrrhenian and Sidra Seas. Its occurrence reveals no feature in common with species belonging to the fauna communities of the upper water layers; nor could we expect it to do so.

All the deep-water euphausiids which we have in our material, except *T. acutifrons* were found by Tattersall in the oceanic area Chesapeake Bay—Bermudas—Florida (Tattersall 1926), but it is striking

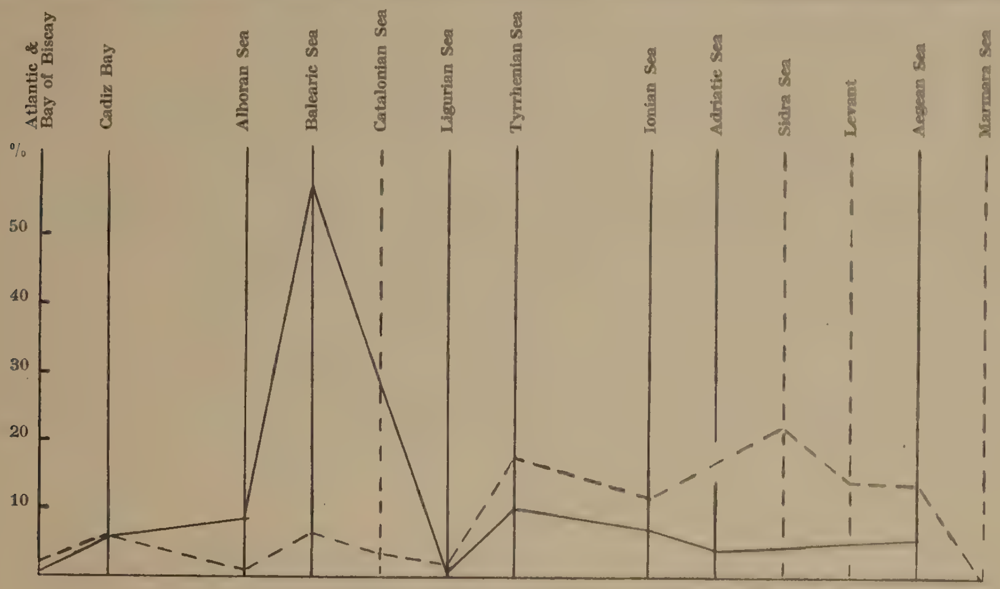

Fig. 22. The relative number per haul of *Stylocheiron abbreviatum* in different areas, ———— 1908—1909, — — — — 1910.

that on the average all species show a deeper vertical distribution there than in our material. Our catches were mainly made at night, but it does not emerge whether Tattersall's material was taken during the day, and that the difference can be due to, or taken as a proof of, diurnal migrations. I assume, however, that the explanation is that in precisely the area investigated by "Bache" the warm surface water in the Atlantic attains its greatest extent. Even at a depth of 400 metres the temperature in this area is above 17° C. It is, therefore, an all but obvious conclusion that our deep-water species tend to go deeper in this warm water than elsewhere in the Atlantic.

The 13 species of euphausiids which are found in the Mediterranean can accordingly be regarded as representatives of 4 different, well-defined fauna communities:—

1. Atlantic-boreal fauna with 2 species, *M. norvegica* and *N. couchii*. These species, which occur in considerably smaller numbers in the Mediterranean than outside, are, in the Mediterranean, found mainly in the western and northern areas, whereas they are rare, and to some extent entirely absent, in the warm water masses in the eastern and southern areas.
2. Temperate-Atlantic fauna with three species, *E. krohnii*, *N. megalops* and *S. longicorne*. These species are found in greater quantities in the Mediterranean than in Cadiz Bay and the Atlantic, and in the Mediterranean they occur in the greatest numbers and with the greatest frequency in the western and northern areas, especially in the Alboran, Balearic, Catalonian and Adriatic Seas, but they are also common in small numbers in the eastern and southern waters.
3. Sub-tropical surface layer fauna with 5 species, *E. brevis*, *E. hemigibba*, *T. aequalis*, *N. atlantica* and *S. suhmii*. These species occur rarely and in small numbers in the westerly areas of the Mediterranean and with the greatest frequency and in largest numbers in the easterly areas, from the Tyrrhenian and Ionian Seas and eastwards.
4. Deep-sea fauna with 3 species, *S. abbreviatum*, *S. maximum* and *T. gregaria*. The first two of these species were found in all areas investigated in the Mediterranean Sea, except the Sea of Marmara, and,

as perhaps we might expect, owing to the uniform conditions in the deeper layer in the whole of the Mediterranean, there is in the distribution of these species no outstanding tendency to a maximum or minimum in particular areas. *T. gregaria*, on the other hand, is probably not stationary inasmuch as its distribution in the western Mediterranean suggests that it continually enters through the Straits of Gibraltar.

The characteristic distribution which the individual species have in the Mediterranean, and which consequently is an expression of the manner in which the different fauna communities react to the various conditions offered by the Mediterranean areas, can be found again in many other pelagic animal groups. For the various groups of animals as a whole it is characteristic that only some of the species which are found in the Atlantic outside Gibraltar are also found in the Mediterranean, and here the individual species show a varying distribution entirely in accord with that we have found for the euphausiids. I have found it to lie outside the scope of this investigation to give a detailed survey of the conditions in the individual groups of animals and the agreements between them which are to be found. I would merely call attention to the general features which are to be found by immediate comparison of the distribution charts for euphausiids with charts of the distribution of Amphipoda and Decapoda (STEPHENSEN, 1918, 1923, 1924, 1926), of Scopelidae (TÅNING, 1918), Sternoptychidae (JESPERSEN & TÅNING, 1926) and, to some extent, of Medusae (KRAMP, 1924).

Five of the 13 euphausiid species which are found in the Mediterranean are otherwise only known from the Atlantic Ocean, namely, *M. norvegica*, *N. couchii*, *E. krohnii*, *N. megalops* and *N. atlantica*. This circumstance makes it little probable that the Mediterranean can have been populated by euphausiids in any other way than from the west through the Straits of Gibraltar. Conditions in regard to *T. gregaria* suggest that an immigration of new species is perhaps still in progress, but as previously remarked the quantitative proportion in the occurrence of the stationary species in the different areas suggests that the supply through the Straits of Gibraltar plays a negligible part in relation to the stock in the Mediterranean. Only exhaustive investigations during all seasons of the year in the inward-flowing surface water and in the Alboran Sea will enable a final answer to be given as to the extent to which the Mediterranean stock of euphausiids is continually recruited from Cadiz Bay.

# BIBLIOGRAPHY.

Bell, Thomas, 1853: A History of the British Stalk-Eyed Crustacea. London.

Bigelow, Henry B., 1926: Plankton of the Offshore Waters of the Gulf of Maine. Bull. of the Bureau of Fisheries. Vol. XL. Washington.

Brandt, F., 1851: Krebse. In: Middendorff's Reise in den äussersten Norden und Osten Sibiriens. Band II. Zoologie. Theil 1. St. Petersburg.

Bruun, Anton Fr., 1935: Flying-Fishes (Exocoetidae) of the Atlantic. Systematic and Biological Studies. Dana-Report No. 6. Copenhagen.

Chun, C., 1896: Atlantis. Biologische Studien über pelagische Organismen. Bibliotheca Zoologica. Bd. 7. Heft 19. Stuttgart.

Claus, C., 1863: Ueber einige Schizopoden und niedere Malacostraken Messina's. Zeitschr. wiss. Zool. Bd. 13. Heft 3. Leipzig.

Colosi, Giuseppe, 1916: Contributo alla conoscenza degli Euphausiacei dello Stretto di Messina. Monit. Zool. Ital. XXVII. Firenze.

— 1917: Eufausiacei raccolti nel Mediterraneo dalla R. nave Washington. Bull. Soc. Ent. Ital. XLVIII. Firenze.

— 1918: Sul genere Meganyctiphanes (Eufausiacei). Monit. Zool. Ital. XXIX. Firenze.

— 1922: Eufausiacei e Misidacei dello Stretto di Messina. R. Comit. Talassogr. Ital. Mem. XCVIII. Venezia.

Deacon, G. E. R., 1933: A general Account of the Hydrology of the South Atlantic Ocean. Discovery Reports. Vol. VII. Cambridge.

Denis, J. R., 1929: Sur les crustacés bathypélagiques de Banyuls-sur-Mer. I. Euphausiacés et Mysjdacés. Archives de Zool. Expérimentale et Générale. Tome 69. Paris.

Fowler, G. H., 1905: Appendix on the Vertical Distribution and Movement of the Schizopoda. Biscayan Plankton. Trans. Linnean Soc. of London. Second Series. Vol. X. Zool. Part V. London.

**Frost, Winifred E.**, 1932: Observations on the Reproduction of Nyctiphanes couchii (Bell) and Meganyctiphanes norvegica (Sars) off the south Coast of Ireland. Proc. Roy. Irish Acad. Vol. XL. Section B. No. 14. Dublin.

— 1934: The Occurrence and Development of Euphausia krohnii off the south-west Coast of Ireland. Ibidem, Vol. XLII, section B, No. 3. Dublin.

**Hansen, H. J.**, 1905, I: Preliminary Report on the Schizopoda collected by H. S. H. Prince Albert of Monaco. Bull. du Musée Océanographique de Monaco. No. 30. Monaco.

— 1905, II: Further Notes on the Schizopoda. Ibidem, No. 42.

— 1908: Crustacea Malacostraca. (I) The Danish Ingolf-Expedition, Vol. III. Part 2. Copenhagen.

— 1910: The Schizopoda of the Siboga Expedition. Siboga Expeditie. Monogr. XXXVII. Leiden.

— 1911: The Genera and Species of the Order Euphausiacea, with Account of remarkable Variation. Bull. de l'Inst. Océanogr. No. 210. Monaco.

— 1912: The Schizopoda. Memoirs of the Museum of Comparative Zoology at Harvard College. Vol. XXXV. No. 4. Cambridge.

— 1913: Report on the Crustacea Schizopoda. Swedish Antarctic Expedition 1901—1903. Copenhagen.

— 1915. The Crustacea Euphausiacea of the United States National Museum. Proc. U. S. National Museum, Vol. 48, No. 2065. Washington.

**Hickling, C. F.**, 1925: Notes on Euphausiids. Journ. Mar. Biol. Assoc. U. K. Vol. XIII. No. 3. Plymouth.

**Hjort, Johan**, 1912: In Murray and Hjort: The Depth of the Ocean. London.

**Hjort, Johan, and Johan T. Ruud**, 1929: Whaling and Fishing in the North Atlantic. Rapp. Proc. Verbaux des Réunions. Vol. LVI. Cons. Perm. Int. pour l'Explor. de la Mer. Copenhagen.

**Holt, E. W. L., and W. M. Tattersall**, 1905: Schizopodous Crustacea from the North-East Atlantic Slope. Department of Agric. and Techn. Instruct. for Ireland. Scientific Investigations. 1902—1903. No. IV.

— 1905: The Schizopoda. Biscayan Plankton. Trans. Linn. Soc. London. Second Series. Vol. X. Zool. Part V. London.

**Illig, G.**, 1909: Ein weiterer Bericht über die Schizopoden der Deutschen Tiefsee-Expedition 1898—99. Zool. Anzeiger. Band XXXV. Leipzig.

**Jespersen, P.**, 1923: On the Quantity of Macroplankton in the Mediterranean and the Atlantic. This Series. Vol. III, 3. Copenhagen.

**Jespersen, P., and Å. Vedel Tåning**, 1926: Mediterranean Sternoptychidæ. This Series, Vol. II. No. 9. Copenhagen.

**Joubin, L., et L. Roule**, 1918: Observations sur la nourriture des Thons de l'Atlantique. Bull. de l'Inst. Océanogr. No. 348. Monaco.

**Kramp, P. L.**, 1913: Schizopoda. Bull. Trimestriel. Cons. Perm. Int. pour l'Explor. de la Mer. Troisième Partie, 9. Copenhagen.

— 1924: Medusæ. This Series Vol. II. No. 8. Copenhagen.

**Lebour, Marie V.**, 1924: The Euphausiidæ in the Neighbourhood of Plymouth and their Importance as Herring Food. Journ. Mar. Biol. Assoc. U. K. Vol. XIII (N. S.) No. 2. Plymouth.

— 1926, I: The Young of Stylocheiron suhmii G. O. Sars and Stylocheiron abbreviatum G. O. Sars (Crustacea), from Mediterranean Plankton. Proc. Zool. Soc. London. I.

— 1926, II: On some larval Euphausiids from the Mediterranean in the Neighbourhood of Alexandria, Egypt. Ibidem, II. London.

**Lo Bianco, Salvatore**, 1901. La pesche pelagiche abissali eseguite dal Maia nelle vicinanze di Capri. Mittheil. aus der Zool. Station zu Neapel. Band 15. Heft 3. Berlin.

— 1903: Le pesche abissali eseguite da F. A. Krupp col Yacht, Puritan nelle adiacenze di Capri ed in altre localita del Mediterraneo. Ibidem Band 16, Heft 1—2. Berlin.

— 1909: Notizie biologiche riguardanti specialmente il periodo di maturità sessuale degli animali del golfo di Napoli. Ibidem. Band 19, Heft 4. Berlin.

**Mackintosh, N. A.**, 1934: Distribution of the Macroplankton in the Atlantic Sector of the Antarctic. Discovery Reports. Vol. IX. Cambridge.

**Masi, L.**, 1905: Sulla presenza della Meganyctiphanes norvegica (M. Sars) nelle acque del Giglio. Annali del Museo Civico di Storia Naturale di Genova. Ser. 3. a. Vol. II. Genova.

**Metschnikow, El.**, 1869: Ueber ein Larvenstadium von Euphausia. Zeitschr. wiss. Zool. Band 19. Heft 4. Leipzig.

— 1871: Ueber den Naupliuszustand von Euphausia. Ibidem, Band 21, Heft 4. Leipzig.

**Nielsen, J. N.**, 1912: Hydrography of the Mediterranean and adjacent waters. This Series, Vol. I. Copenhagen.

**Ortmann, Arnold**, 1893: Decapoden und Schizopoden. Ergebn. der Plankton-Expedition der Humboldt-Stiftung. Bd. II G. b. Kiel und Leipzig.

**Raab, Franz**, 1915: Beitrag zur Anatomie und Histologie der Euphausiiden. Arbeiten aus den Zool. Inst. Univ. Wien und Zool. Stat. Triest. Tome XX. Wien.

**Russell, F. S.**, 1928: The Vertical Distribution of Marine Macroplankton. VII. Observations on the Behaviour of Calanus finmarchicus. Journ. Mar. Biol. Assoc. U. K. Vol. XV (N. S.). Plymouth.

**Rustad, Ditlef**, 1930: Euphausiacea with Notes on their Biogeography and Development. Scient. Res. Norw. Antarctic Exped. 1927—28 and 1928—29. No. 5. Oslo.

**Ruud, Johan T.**, 1928: Fluctuations in the Larval Stages of Euphausiidae off Møre 1926—1927. Journ. du Conseil. Vol. III. Cons. Perm. Int. pour l'Explor. de la Mer. Copenhagen.

— 1932: On the Biology of southern Euphausiidae. Hvalrådets Skrifter. Nr. 2. Det Norske Vid. Ak. i Oslo. Oslo.

**Sars, G. O.**, 1883: Preliminary Notices on the Schizopoda of H. M. S. "Challenger" Expedition. Christiania Vid. Selsk. Forh. 1883, No. 7. Christiania.

— 1885: Report on the Schizopoda. Rep. Scient. Res. Voyage of H. M. S. Challenger. Zoology. Vol. XIII. Part XXXVII. London.

Sars, M., 1856: Om tre nye norske Krebsdyr. Forh. Skand. Naturf. Møde i Christiania, 1856. Christiania.

Schmidt, Johs., 1912: Introduction. This Series, Vol. I. Copenhagen.

Schott, Gerhard, 1912: Geographie des Atlantischen Ozeans. Hamburg.

Spärck, R., 1931: Some quantitative investigations on the bottom fauna at the west coast of Italy, in the Bay of Algiers, and at the coast of Portugal. This Series. Vol. III. No. 7. Copenhagen.

Stephensen, K., 1918: Hyperiidea-Amphipoda (part 1). This Series Vol. II. No. 5. Copenhagen.

— 1923. Decapoda-Macrura (excl. Sergestidæ). This Series Vol. II. No. 7. Copenhagen.

— 1924: Hyperiidea-Amphipoda (part 2). This Series Vol. II No. 8. Copenhagen.

— 1926: Hyperiidea-Amphipoda (part 3). This Series Vol. II. No. 9. Copenhagen.

Tattersall, Walter M., 1909: The Schizopoda collected by the Maia and Puritan in the Mediterranean. Mittheil. aus der Zool. Stat. zu Neapel. Band 19, Heft 2. Berlin.

— 1924: Euphausiacea. Brit. Ant. ("Terra Nova") Exped. 1910. Nat. Hist. Rep. Zoology. Vol. VIII. No. 1. Crustacea. Part VIII. London.

— 1926: Crustaceans of the Order Euphausiacea and Mysidacea from the western Atlantic. Proc. U. S. National Museum. Vol. 59. No. 2634. Washington.

Wüst, Georg, 1928: Der Ursprung der Atlantischen Tiefenwässer. Zeitschr. d. Gesell. für Erdkunde zu Berlin. Jubiläums-Sonderband. 1928. Berlin.

Zimmer, Carl, 1909: Die Nordischen Schizopoden. Nordisches Plankton. VI.

— 1913: Untersuchungen über den inneren Bau von Euphausia superba Dana. Zoologica. Band 26. Stuttgart.

— 1914: Die Schizopoden der Deutschen Südpolar-Expedition 1901—1903. Deutsche Südpolar-Expedition 1901—1903. Band XV. Zoologie Band VII. Heft 4. Berlin.

— 1915: Zur Kenntnis der Schizopodenfauna Neapels. Mittheil. aus der Zool. Stat. zu Neapel. Band 22. Berlin.

— 1927: Euphausiacea. Handbuch der Zoologie. Dritter Band. Erste Hälfte. Berlin.

# LIST OF MATERIAL

| | Atlantic 1905 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station | 82 | | 88 | 93 | 32 | 35 | 36 | | | 37 | | 41 | | | 42 |
| Date | $^{15}/_{6}$ | | $^{30}/_{6}$ | $^{25}/_{6}$ | $^{7}/_{8}$ | $^{8}/_{8}$ | $^{10}/_{8}$ | | | $^{10}/_{8}$ | | $^{14}/_{8}$ | | | $^{15}/_{8}$ |
| Position | 51°00′ N.<br>11°43′ W. | | 48°09′ N.<br>8°30′ W. | 49°25′ N.<br>12°20′ W. | 48°40′ N.<br>5°04′ W. | 47°05′ N.<br>4°26′ W. | 44°21′ N.<br>2°37′ W. | | | 44°01′ N.<br>2°49′ W. | | 43°23′ N.<br>2°01′ W. | | | 43°31′ N.<br>2°13′ W. |
| Depth in metres | 840<br>1400 | 1350<br>840 | 600<br>995 | 1280<br>1310 | 113 | 146 | 1125 | 1050<br>1035 | 1125 | 1400 | | 102 | | | 348 |
| Trawl or net | Y. 330 | Y. 330 | Y. 200 | Y. 330 | Y. 200 | Y. 200 | Y. 330 | Y. 330 | Y. 330 | Y. 330 | Y. 330 | Y. 330 | Y. 330 | Y. 330 | Y. 200 |
| Length of wire in metres | 800 | 1200 | 300 | 200 | 120 | 60 | 300 | 800 | 1250 | 200 | 300 | 15 | 60 | 120 | 70 |
| Duration of haul in hours | 2 | 2 | 2 | 2 | $^{1}/_{2}$ | $^{1}/_{2}$ | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 |
| Hour | $15^{45}$ | $12^{45}$ | $20^{45}$ | $1^{15}$ | $22^{15}$ | $20^{10}$ | $2^{55}$ | $0^{05}$ | $5^{55}$ | $21^{55}$ | $19^{05}$ | $23^{00}$ | $20^{45}$ | $18^{30}$ | $10^{30}$ |
| 1. *Bentheuphausia amblyops* | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| 2. *Thysanopoda obtusifrons* | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| 3. *Thysanopoda aequalis* | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| 4. *Thysanopoda acutifrons* | 11 | 100 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| 5. *Thysanopoda microphth.* | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| 6. *Thysanopoda pectinata* | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| 7. *Meganyctiphanes norv.* | . . | 1 | 6 | . . | . . | 1 | 13 | 1 | 52 | 2 | 5 | . . | . . | . . | 11 |
| 8. *Nyctiphanes couchii* | . . | . . | . . | . . | 2 | 383 | . . | . . | . . | . . | 1 | 62 | 5 | 18 | . . |
| 9. *Euphausia krohnii* | 22 | 8 | 4 | . . | . . | . . | 2 | . . | . . | . . | 1 | . . | . . | . . | . . |
| 10. *Euphausia brevis* | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| 11. *Euphausia hemigibba* | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| 12. *Euphausia gibboides* | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| 13. *Thysanoessa inermis* | 1 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| 14. *Thysanoessa longicaudata* | 2 | 3 | . . | 1 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| 15. *Thysanoessa gregaria* | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| 16. *Nematoscelis megalops* | . . | . . | 2 | . . | . . | . . | . . | 4 | 1 | . . | 17 | . . | . . | . . | . . |
| 17. *Nematoscelis tenella* | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| 18. *Nematoscelis microps* | | | | | | | | . | . | . | . . | . | . . | . . | . . |
| 19. *Nematoscelis atlantica* | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| 20. *Nematobrachion boopis* | 3 | 10 | 1 | . . | . . | . . | . . | 21 | 10 | . . | . . | . . | . . | . . | . . |
| 21. *Nematobrachion flexipes* | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| 22. *Stylocheiron carinatum* | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| 23. *Stylocheiron elongatum* | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| 24. *Stylocheiron longicorne* | 48 | 6 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| 25. *Stylocheiron suhmii* | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| 26. *Stylocheiron maximum* | 6 | . . | . . | . . | . . | . . | . . | . . | . . | . . | 1 | . . | . . | . . | . . |
| 27. *Stylocheiron abbreviatum* | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |

Table I

Atlantic

| Station | 69 | 72 | 74 | | 76 | | | | 77 | 80 | 83 | 88 | 89 | 166 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | $^{7}/_{6}$ | $^{9}/_{6}$ | $^{10}/_{6}$ | | $^{11-12}/_{6}$ | | | | $^{18}/_{6}$ | $^{19}/_{6}$ | $^{20}/_{6}$ | $^{23}/_{6}$ | $^{23}/_{6}$ | $^{25}/_{8}$ |
| Position | 47°40′ N.<br>12°41′ W. | 48°41′ N.<br>11°30′ W. | 49°23′ N.<br>12°13′ W. | | 49°27′ N.<br>13°33′ W. | | | | 50°45′ N.<br>11°53′ W. | 51°34′ N.<br>11°50′ W. | 51°58′ N.<br>10°25′ W. | 55°05′ N.<br>12°20′ W. | 55°45′ N.<br>9°35′ W. | 50°40′ N.<br>9°32′ W. |
| Depth in metres | > 4000 | 2600 | 1245 | 1245<br>1298 | > 2600 | | | | 2000 | 1140 | 81 | ~ 1800 | 1600 | 125 |
| Trawl or net | Y. 330 | Y. 330 | Y. 330 | Y. 330 | Y. 330 | Y. 330 | Y. 200 | Y. 200 | Y. 330 | Y. 200 | Y. 330 | Y. 200 | Y. 200 | Y. 200 |
| Length of wire in metres | 200 | 200 | 200 | 2000 | 100 | 200 | 800 | 2800 | 200 | 1200 | 60 | 300 | 200 | 200 |
| Duration of haul in hours | 1 | 1 | 2 | 1 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 2 | 2 | 1 |
| Hour | $22^{50}$ | $22^{15}$ | $3^{10}$ | $6^{35}$ | $0^{20}$ | $2^{40}$ | $18^{15}$ | $15^{00}$ | $1^{45}$ | $18^{30}$ | $11^{35}$ | $21^{50}$ | $2^{05}$ | $14^{00}$ |
| 1. *Bentheuphausia amblyops* | . . | . . | . . | 2 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| 2. *Thysanopoda obtusifrons* | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| 3. *Thysanopoda aequalis* | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| 4. *Thysanopoda acutifrons* | . . | . . | . . | 16 | . . | . . | . . | 27 | . . | . . | . . | . . | . . | . . |
| 5. *Thysanopoda microphth.* | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . | . . | . . | . . |
| 6. *Thysanopoda pectinata* | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| 7. *Meganyctiphanes norv.* | 5 | 1 | 1 | 5 | 16 | 1 | 1 | 5 | 1 | 51 | . . | 1 | 38 | 31 |
| 8. *Nyctiphanes couchii* | . . | . . | . . | . . | . . | . . | . . | . . | . . | . | 1 | . . | . . | 63 |
| 9. *Euphausia krohnii* | . . | 2 | 2 | 10 | 6 | 4 | 5 | 22 | . | 4 | . . | . . | . . | . . |
| 10. *Euphausia brevis* | . . | . . | . . | . . | . . | . . | . . | . | . | . . | . | . . | . . | . . |
| 11. *Euphausia hemigibba* | . . | . . | . . | . . | . . | . . | . . | . | . . | . | . | . . | . . | . . |
| 12. *Euphausia gibboides* | . . | . . | . . | . . | . . | . . | . . | . | . | . | . | . . | . . | . . |
| 13. *Thysanoessa inermis* | . . | . . | . . | . . | . . | . . | . . | . | . | . . | . | . . | . . | 67 |
| 14. *Thysanoessa longicaudata* | 2 | . . | . . | . . | . . | . . | 4 | 9 | . . | 3 | . | . . | 22 | . . |
| 15. *Thysanoessa gregaria* | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| 16. *Nematoscelis megalops* | . . | . . | 2 | 9 | . . | 2 | 1 | 1 | 1 | . . | . | . . | 13 | . . |
| 17. *Nematoscelis tenella* | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . | . . | . . | . . |
| 18. *Nematoscelis microps* | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| 19. *Nematoscelis atlantica* | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . | . . | . . | . . |
| 20. *Nematobrachion boopis* | . . | . . | . . | 37 | . . | . . | 3 | 9 | . . | 1 | . . | . . | . . | . |
| 21. *Nematobrachion flexipes* | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . | . . | . . | . . |
| 22. *Stylocheiron carinatum* | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . | . . | . . | . . |
| 23. *Stylocheiron elongatum* | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . | . . | . . | . . |
| 24. *Stylocheiron longicorne* | . . | . . | . . | 5 | . . | . . | . . | 21 | . . | . . | . | . . | . . | . . |
| 25. *Stylocheiron suhmii* | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . | . . | . . | . . |
| 26. *Stylocheiron maximum* | . . | . . | . . | 4 | . . | . . | 5 | . . | . . | 2 | . | . . | . . | . . |
| 27. *Stylocheiron abbreviatum* | . . | . . | . . | . . | . . | . . | . . | 3 | . . | . . | . | . . | . . | . . |

Atlantic 1906

| 43 | | 45 | 46 | | 47 | 49 | 52 | 56 | 60 | 61 | 62 | | | 65 | 67 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 16/5 | | 16/5 | 17/5 | | 17/5 | 18/5 | 21/5 | 28/5 | 31/5 | 1/6 | 4-5/6 | | | 6/6 | 7/6 | |
| 43°37′ N.<br>2°08′ W. | | 44°19′ N.<br>1°51′ W. | 44°37′ N.<br>2°17′ W. | | 45°00′ N.<br>2°57′ W. | 46°13′ N.<br>4°24′ W. | 48°43′ N.<br>12°05′ W. | 51°21′ N.<br>10°20′ W. | 51°27′ N.<br>11°10′ W. | 51°01′ N.<br>11°39′ W. | 50°25′ N.<br>12°41′ W. | | | 49°04′ N.<br>14°52′ W. | [illegible] N.<br>14°15′ W. | |
| 1650<br>1030 | 1030<br>1290 | 125 | 1360 | | 1015 | 1560<br>590 | 1860<br>1910 | 130 | 198 | 1320<br>1020 | 2480 | | 2775 | 6020 | 4000 | |
| Y. 330 | Y. 330 | Y. 330 | P. 100 | Y. 330 | Y. 330 | Y. 330 | Y. 330 | Y. 330 | Y. 330 | Y. 330 | Y. 330 | Y. 330 | Y. 330 | Y. 330 | Y. 330 | An. T. |
| 250 | 600 | 60 | Surf. | 300 | 300 | 300 | 300 | 25 | 50 | 300 | 200 | 300 | 1500 | 300 | 200 | 1700 |
| 2 | 2 | 1/2 | 1/12 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| $2^{45}$ | $5^{20}$ | $19^{35}$ | $1^{55}$ | $1^{45}$ | $14^{25}$ | $10^{45}$ | $0^{35}$ | $23^{10}$ | $0^{40}$ | $7^{45}$ | $0^{15}$ | 21[illegible] | $2^{45}$ | $7^{00}$ | $1^{05}$ | $6^{00}$ |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 2 | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 1 | .. | .. | 1 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 1 | 2 | .. | 35 | 2 | .. | 4 | .. | 3 | 1 | 2 | .. | .. | .. | .. | .. | .. |
| .. | .. | 5 | .. | .. | .. | .. | .. | 23 | 2 | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | 1 | .. | 4 | .. | .. | 1 | 1 | 3 | 5 | .. | 1 | 2 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 11 | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | 1 | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 5 | .. | 3 | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | 2 | .. | .. | .. | .. | .. | .. | 1 | 3 | 11 | .. | .. | 2 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 2 | 16 | .. | .. | [illegible] |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | 2 | .. | .. | .. | .. | .. | .. | 5 | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | 1 | .. | .. | .. | .. | .. | .. | 4 | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |

(continued).

1906

| 167 | | 173 | 175 | | 176 | 178 | | | | 179 | | | 180 | 181 | 182 | 190 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26/8 | | 30/8 | 30/8 | | 31/8 | 2/9 | | | | 2-3/9 | | | [illegible] | [illegible] | [illegible] | 11/9 |
| 51°28′ N.<br>11°50′ W. | | 50°31′ N.<br>11°37′ W. | 51°11′ N.<br>11°41′ W. | | 49°31′ N.<br>11°51′ W. | 48°04′ N.<br>12°40′ W. | | | | 47°20′ N.<br>12°23′ W. | | | 48°19′ N.<br>[illegible] W. | 49°22′ N.<br>12°52′ W. | 50°11′ N.<br>12°05′ W. | 46°30′ N.<br>7°00′ W. |
| 1300<br>1160 | 1220<br>1300 | 390<br>450 | 930<br>970 | 1050 | 1125<br>1075 | 4000 | | | | > 4000 | | | > 4000 | 1350 | > 2200 | > 4000 |
| Y. 330 | Y. 200 | Y. 330 | Y. 330 | Y. 330 | Y. 330 | Y. 330 | Y. 330 | Y. 330 | Y. 330 | Y. 330 | Y. 330 | Y. 330 | Y. 330 | Y. 330 | Y. 330 | Y. 330 |
| 200 | 300 | 200 | 300 | 1050 | 300 | 300 | 600 | 1000 | 1800 | 300 | 600 | 1800 | 1800 | 1800 | 600 | 2700 |
| 2 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 1/4 |
| $10^{30}$ | $8^{00}$ | $8^{15}$ | $14^{45}$ | $19^{00}$ | $21^{30}$ | $3^{15}$ | $5^{40}$ | $7^{05}$ | $9^{05}$ | $21^{30}$ | $0^{00}$ | $3^{40}$ | $17^{00}$ | $10^{45}$ | $18^{45}$ | $8^{35}$ |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | 2 | .. | .. | 1 | 1 | 4 | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | 2 | .. | .. | .. | .. | 20 | .. | 17 | .. | 26 | 26 | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 11 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 1 | .. | 1 | 1 | 1 | 22 | .. | .. | .. | .. | .. | 3 | .. | 33 | 1 | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | 14 | 46 | 4 | 3 | 10 | 550 | 2 | 247 | 6 | 550 | 98 | .. | 858 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 13 | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 1 | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | 2 | .. | .. | .. | .. | 410 | .. | .. | 2 | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 1 | .. | .. | .. | 3 | 85 | 2 | .. | 2 | 25 | .. | 65 | 4 | 211 | 6 | 1 | 1 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | 10 | 1 | 3 | .. | 1 | 21 | .. | 21 | 1 | 23 | 30 | 5 | 30 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | 1 | 72 | .. | .. | 1 | 29 | 2 | 10 | .. | 122 | 19 | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | 1 | .. | .. | 4 | 6 | .. | .. | 2 | 9 | .. | 23 | 1 | 9 | 8 | .. | 1 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |

Tab

Atla

| Station | 1 | 4 | 8 | 62 | | 63 | | 65 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | $^{28}/_{11}$ 08 | $^{1}/_{12}$ 08 | $^{4}/_{12}$ 08 | $^{21}/_{2}$ 09 | | $^{22}/_{2}$ 09 | | $^{24}/_{2}$ 09 | | | |
| Position | 49°17′ N.<br>4°13′ W. | 45°20′ N.<br>7°42′ W. | 36°33′ N.<br>7°36′ W. | 35°45′ N.<br>5°59′ W. | | 35°50′ N.<br>6°03′ W. | | 35°53′ N.<br>7°26′ W. | | | |
| Depth in metres | 94 | > 4000 | > 600 | 58 | | 490 | | 1300 | | | |
| Trawl or net | Y. 200 | C. 130 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 |
| Length of wire in metres | 25 | 1500 | 65 | 25 | 100 | 25 | 600 | 25 | 65 | 300 | 600 |
| Duration of haul in hours | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | 1 | $^{1}/_{2}$ | 1 | 2 | 2 |
| Hour | $2^{50}$ | $11^{45}$ | $20^{20}$ | $21^{10}$ | $20^{26}$ | $0^{05}$ | $1^{45}$ | $5^{50}$ | $6^{30}$ | $7^{45}$ | $10^{00}$ |
| 1. *Bentheuphausia amblyops* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 2. *Thysanopoda obtusifrons* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 3. *Thysanopoda aequalis* | .. | .. | .. | .. | 1 | .. | .. | .. | .. | .. | .. |
| 4. *Thysanopoda acutifrons* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 5. *Thysanopoda microphth.* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 6. *Thysanopoda pectinata* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 7. *Meganyctiphanes norv.* | .. | .. | 23 | .. | .. | .. | .. | .. | 19 | 11 | .. |
| 8. *Nyctiphanes couchii* | 120 | .. | .. | 878 | 147 | 10 | 7 | .. | .. | .. | .. |
| 9. *Euphausia krohnii* | .. | 82 | 5 | 2 | 6 | 7 | 12 | 38 | 20 | .. | 44 |
| 10. *Euphausia brevis* | .. | .. | .. | .. | .. | .. | r. | 27 | 30 | .. | 7 |
| 11. *Euphausia hemigibba* | .. | .. | .. | .. | .. | .. | 1 | .. | 40 | .. | .. |
| 12. *Euphausia gibboides* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 65 |
| 13. *Thysanoessa inermis* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 14. *Thysanoessa longicaudata* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 15. *Thysanoessa gregaria* | .. | .. | .. | .. | 1 | .. | 27 | 10 | 200 | 19 | 4 |
| 16. *Nematoscelis megalops* | .. | .. | .. | 1 | 3 | .. | 5 | 5 | 1 | 11 | 10 |
| 17. *Nematoscelis tenella* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 18. *Nematoscelis microps* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 2 |
| 19. *Nematoscelis atlantica* | .. | .. | .. | .. | .. | .. | 1 | 1 | 16 | 1 | .. |
| 20. *Nematobrachion boopis* | .. | .. | .. | 1 | .. | .. | .. | .. | .. | .. | 11 |
| 21. *Nematobrachion flexipes* | .. | .. | .. | .. | .. | .. | .. | .. | 12 | .. | 18 |
| 22. *Stylocheiron carinatum* | .. | .. | .. | .. | .. | .. | .. | 1 | .. | .. | .. |
| 23. *Stylocheiron elongatum* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 113 |
| 24. *Stylocheiron longicorne* | .. | .. | .. | 1 | .. | .. | 44 | .. | .. | 3 | 21 |
| 25. *Stylocheiron suhmii* | .. | .. | .. | .. | .. | .. | .. | 1 | .. | .. | .. |
| 26. *Stylocheiron maximum* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 2 |
| 27. *Stylocheiron abbreviatum* | .. | .. | .. | .. | .. | .. | 2 | .. | 4 | 7 | 6 |

Tab

Atlantic, Winter 1908—1

| Station | 71 | | | | | 73 | 74 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | $^{4\text{-}5}/_{3}$ 09 | | | | | $^{8}/_{3}$ 09 | $^{8\text{-}9}/_{3}$ 09 | | | | |
| Position | 39°35′ N.<br>9°45′ W. | | | | | 43°46′ N.<br>8°11′W. | 44°21′ N.<br>7°55′ W. | | | | |
| Depth in metres | > 1300 | | | | | 180 | > 3000 | | | | |
| Trawl or net | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 |
| Length of wire in metres | 25 | 65 | 300 | 600 | 1600 | 65 | 25 | 65 | 300 | 600 | 25 |
| Duration of haul in hours | $^{1}/_{2}$ | 1 | 2 | 2 | 2 | $^{1}/_{2}$ | $^{1}/_{2}$ | 1 | 1 | 1 | 1 |
| Hour | $0^{06}$ | $22^{50}$ | $20^{40}$ | $18^{25}$ | $16^{00}$ | $15^{30}$ | $2^{40}$ | $1^{30}$ | $22^{50}$ | $0^{10}$ | $22^{15}$ |
| 1. *Bentheuphausia amblyops* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 2. *Thysanopoda obtusifrons* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 3. *Thysanopoda aequalis* | .. | .. | .. | .. | 1 | .. | .. | .. | .. | .. | .. |
| 4. *Thysanopoda acutifrons* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 5. *Thysanopoda microphth.* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 6. *Thysanopoda pectinata* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 7. *Meganyctiphanes norv.* | 119 | 18 | 1 | 23 | 5 | .. | 48 | 120 | 1103 | 214 | 94 |
| 8. *Nyctiphanes couchii* | .. | .. | .. | .. | 1 | 74 | .. | .. | 3 | .. | .. |
| 9. *Euphausia krohnii* | 1 | .. | .. | .. | .. | .. | 5 | 3 | 62 | 8 | .. |
| 10. *Euphausia brevis* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 11. *Euphausia hemigibba* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 12. *Euphausia gibboides* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 13. *Thysanoessa inermis* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 14. *Thysanoessa longicaudata* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 15. *Thysanoessa gregaria* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 16. *Nematoscelis megalops* | 7 | 6 | 20 | 7 | 9 | .. | 11 | 43 | 20 | 8 | .. |
| 17. *Nematoscelis tenella* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 18. *Nematoscelis microps* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 19. *Nematoscelis atlantica* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 20. *Nematobrachion boopis* | .. | .. | .. | 7 | 5 | .. | .. | .. | .. | 14 | .. |
| 21. *Nematobrachion flexipes* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 22. *Stylocheiron carinatum* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 23. *Stylocheiron elongatum* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 24. *Stylocheiron longicorne* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 25. *Stylocheiron suhmii* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 26. *Stylocheiron maximum* | .. | .. | .. | .. | 1 | .. | .. | .. | 2 | 4 | .. |
| 27. *Stylocheiron abbreviatum* | .. | .. | .. | .. | 1 | .. | .. | .. | .. | .. | .. |

(continued).

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| 66 | | | | | 68 | | 69 | | | | | | 70 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $^{25}/_{3}$ 09 | | | | | $^{27}/_{3}$ 09 | | $^{28}/_{3}$ 09 | | | | | | $^{1}/_{4}$ 09 |
| 36°16′ N.<br>6°52′ W. | | | | | 36°39′ N.<br>7°21′ W. | | 36°13′ N.<br>9°44′ W. | | | | | | 39°06′ N.<br>9°17′ W. |
| 735 | | | | | 550 | | > 3500 | | | | | | 94 |
| Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | C. 200 | Y. 200 |
| 25 | 65 | 300 | 600 | 1200 | 65 | 800 | 25 | 65 | 300 | 300 | 600 | 3000 | 65 |
| $^{1}/_{2}$ | 1 | 2 | 2 | 2 | $^{1}/_{2}$ | $^{3}/_{4}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | 1 | 1 | 1 |
| $1^{05}$ | $1^{45}$ | $2^{55}$ | $5^{15}$ | $8^{30}$ | $19^{00}$ | $17^{55}$ | $0^{30}$ | $22^{45}$ | $15^{05}$ | $23^{40}$ | $21^{00}$ | $18^{30}$ | $9^{00}$ |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | 5 | 12 | 12 | .. | .. | 3 | 11 | 1 | 11 | 2 | .. | .. |
| .. | .. | .. | .. | 8 | .. | .. | .. | .. | .. | .. | .. | 3 | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 1888 | 821 | 282 | 117 | 37 | .. | 516 | 51 | 75 | .. | 109 | 39 | 6 | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 283 |
| 8 | 2 | 3 | 24 | 28 | 6 | 1 | 1 | 61 | .. | 4 | 4 | .. | .. |
| .. | .. | 1 | .. | 3 | 8 | 2 | 2 | .. | .. | 12 | 5 | .. | .. |
| .. | .. | 3 | 20 | 31 | .. | .. | 1 | 7 | 1 | 15 | 7 | .. | .. |
| .. | .. | 2 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | 1 | 20 | 3 | .. | 5 | 5 | 8 | 1 | 36 | 22 | .. | .. |
| .. | .. | 13 | 12 | 2 | .. | 2 | 1 | 1 | .. | 7 | .. | 1 | .. |
| .. | .. | .. | .. | 5 | .. | .. | .. | .. | .. | 1 | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 2 | 7 | .. | .. |
| .. | .. | 1 | 40 | 66 | .. | 2 | .. | .. | .. | 25 | .. | .. | .. |
| .. | .. | .. | 40 | 90 | 3 | 86 | .. | .. | .. | .. | 79 | .. | .. |
| .. | .. | 8 | .. | 2 | .. | .. | 60 | 13 | .. | 5 | 1 | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | 244 | 12 | .. | 2 | .. | .. | .. | .. | 1 | .. | .. |
| .. | .. | .. | 124 | 4 | 1 | 24 | 1 | 2 | 2 | 3 | 55 | 2 | .. |
| .. | .. | .. | .. | .. | .. | .. | 1 | 9 | 1 | 8 | 1 | .. | .. |
| .. | .. | .. | .. | 1 | .. | 3 | .. | .. | .. | 2 | 1 | 1 | .. |
| .. | .. | 4 | 25 | 2 | .. | 7 | 1 | 7 | 5 | 15 | 6 | .. | .. |

(continued).

| | | | | | | | | | Atlantic Summer 1910 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 75 | | | 76 | | | | | 78 | 79 | 80 | | | 81 | |
| $^{9}/_{3}$ 09 | | | $^{10}/_{3}$ 09 | | | | | $^{13}/_{3}$ 09 | $^{13}/_{6}$ | $^{13}/_{6}$ | | | $^{15}/_{6}$ | |
| 45°37′ N.<br>7°03′ W. | | | 47°01′ N.<br>5°48′ W. | | | | | 51°04′ N.<br>1°35′ E. | 47°30′ N.<br>6°43′ W. | 46°17′ N.<br>7°31′ W. | | | 41°32′ N.<br>9°32′ W. | |
| > 4000 | | | > 1200 | | | | | 49 | > 150 | > 4000 | | | 2140 | |
| Y. 200 | Y. 200 | C. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 |
| 300 | 600 | 4300 | 25 | 65 | 300 | 600 | 1600 | 65 | 65 | 25 | 65 | 300 | 300 | 500 |
| 1 | 1 | 2 | $^{1}/_{2}$ | 1 | 1 | 1 | 1 | $^{1}/_{2}$ | $^{1}/_{4}$ | $^{1}/_{4}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ |
| $19^{45}$ | $18^{30}$ | $13^{45}$ | $19^{15}$ | $18^{05}$ | $11^{30}$ | $13^{15}$ | $14^{40}$ | $15^{35}$ | $8^{40}$ | $23^{30}$ | $22^{00}$ | $22^{45}$ | $16^{00}$ | $16^{50}$ |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 444 | 104 | 3 | 37 | 2 | .. | 7 | 10 | .. | .. | 9500 | 12800 | 162 | 633 | 14 |
| .. | .. | .. | .. | 1 | 17 | 3 | .. | 7 | 31 | .. | .. | .. | 266 | 5 |
| 29 | 21 | 11 | .. | 1 | .. | .. | .. | .. | .. | 16 | .. | 1 | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 11 | 7 | .. | .. | 1 | .. | .. | .. | .. | .. | .. | .. | .. | 89 | 28 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 1 | .. |
| .. | 38 | .. | .. | .. | .. | 6 | 12 | .. | .. | .. | .. | .. | 1 | 21 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | 1 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 2 | 2 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | 5 | .. | .. | .. | .. | 1 | 2 | .. | .. | .. | .. | .. | 1 | .. |
| .. | .. | .. | .. | 1 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |

Table

Atlantic

| Station | 85 | 87 | | 89 | | | 91 | | 95 | | 96 | 229 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 17/6 | 17/6 | | 18/6 | | | 18/6 | | 23/6 | | 23/6 | 8/9 | | |
| Position | 38°22′ N.<br>9°28′ W. | 37°03′ N.<br>9° 15′ W. | | 36°28′ N.<br>8°22′ W. | | | 35°53′ N.<br>7°26′ W. | | 35°57′ N.<br>6°00′ W. | | 35°48′ N.<br>5°58′ W. | 35°51′ N.<br>5°58′ W. | | |
| Depth in metres | > 700 | 1580 | | 1310 | | | 1225 | | 275 | | 185 | 720 | | |
| Trawl or net | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 |
| Length of wire in metres | 65 | 65 | 300 | 65 | 300 | 1000 | 300 | 1600 | 65 | 300 | 65 | 25 | 300 | 25 |
| Duration of haul in hours | 1/4 | 1/4 | 1/2 | 1/4 | 1/2 | 1/2 | 3/4 | 1 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 |
| Hour | $2^{00}$ | $16^{40}$ | $16^{00}$ | $3^{00}$ | $3^{25}$ | $4^{10}$ | $18^{55}$ | $17^{25}$ | $5^{50}$ | $5^{10}$ | $9^{30}$ | $4^{55}$ | $5^{40}$ | $0^{15}$ |
| 1. *Bentheuphausia amblyops* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 2. *Thysanopoda obtusifrons* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 3. *Thysanopoda aequalis* | .. | .. | .. | 43 | 41 | 49 | .. | 98 | .. | .. | .. | .. | .. | 29 |
| 4. *Thysanopoda acutifrons* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 5. *Thysanopoda microphth.* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 6. *Thysanopoda pectinata* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 7. *Meganyctiphanes norv.* | 5100 | .. | 1 | 30 | 19 | 2 | .. | 2 | .. | .. | .. | .. | .. | 65 |
| 8. *Nyctiphanes couchii* | .. | .. | .. | .. | .. | .. | .. | .. | 1 | .. | 1 | 14 | 27 | .. |
| 9. *Euphausia krohnii* | .. | 1 | .. | 221 | 22 | 8 | 14 | 4 | .. | .. | .. | 1 | 10 | 32 |
| 10. *Euphausia brevis* | .. | .. | .. | 148 | 24 | 11 | 141 | 34 | .. | .. | .. | .. | .. | 62 |
| 11. *Euphausia hemigibba* | .. | .. | .. | 300 | 90 | 38 | 2 | 174 | .. | .. | .. | .. | .. | 182 |
| 12. *Euphausia gibboides* | .. | .. | .. | .. | 36 | 3 | 10 | 7 | .. | .. | .. | .. | .. | 5 |
| 13. *Thysanoessa inermis* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 14. *Thysanoessa longicaudata* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 15. *Thysanoessa gregaria* | .. | 1 | .. | .. | 1 | 1 | 9 | .. | 2 | 1 | .. | .. | .. | .. |
| 16. *Nematoscelis megalops* | .. | .. | .. | .. | 31 | 6 | 4 | 10 | .. | .. | 1 | 3 | 13 | 1 |
| 17. *Nematoscelis tenella* | .. | .. | .. | .. | 25 | 9 | 35 | 23 | .. | .. | .. | .. | .. | .. |
| 18. *Nematoscelis microps* | .. | .. | .. | .. | 45 | 22 | 62 | 44 | .. | .. | .. | .. | .. | .. |
| 19. *Nematoscelis atlantica* | .. | .. | .. | 16 | 99 | 57 | 60 | 80 | .. | .. | .. | .. | .. | 3 |
| 20. *Nematobrachion boopis* | .. | .. | .. | .. | .. | 38 | .. | 46 | .. | .. | .. | .. | .. | .. |
| 21. *Nematobrachion flexipes* | .. | .. | .. | .. | 15 | 4 | 5 | 4 | .. | .. | .. | .. | .. | .. |
| 22. *Stylocheiron carinatum* | .. | .. | .. | 4 | 1 | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 23. *Stylocheiron elongatum* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 24. *Stylocheiron longicorne* | .. | 1 | 53 | .. | 45 | 51 | 58 | 23 | .. | 6 | .. | .. | 4 | .. |
| 25. *Stylocheiron suhmii* | .. | .. | .. | 1 | .. | .. | 4 | .. | .. | .. | .. | .. | .. | .. |
| 26. *Stylocheiron maximum* | .. | .. | 5 | .. | .. | 7 | .. | .. | .. | .. | .. | .. | .. | .. |
| 27. *Stylocheiron abbreviatum* | .. | .. | 1 | .. | 52 | 30 | 132 | 19 | 2 | 14 | .. | .. | 1 | .. |

Table

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| Station | 240 | | | 242 | | 243 | 244 | 245 | | | | 246 | 247 | 248 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 15/9 | | | 16/9 | | 17/9 | 17/9 | 17/9 | | | | 18/9 | 19/9 | 20/9 |
| Position | 44°34′ N.<br>8°16′ W. | | | 46°19′ N.<br>6°48′ W. | | 46°43′ N.<br>6°28′ W. | 47°08′ N.<br>6°08′ W. | 47°14′ N.<br>6°02′ W. | | | | 48°02′ N.<br>5°23′ W. | 48°43′ N.<br>4°45′ W. | 49°52′<br>2°20′ |
| Depth in metres | > 4000 | | | > 4000 | | > 4270 | > 900 | > 460 | | 182<br>330 | 330<br>> 460 | 90 | > 100 | > 100 |
| Trawl or net | Y. 200 | Y. 200 | Y. 200 | Y. 200 | C. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 20 |
| Length of wire in metres | 25 | 300 | 1000 | 65 | 4350 | 65 | 1000 | 65 | 150 | 250 | 400 | 100 | 65 | 65 |
| Duration of haul in hours | 1/4 | 1/4 | 1/2 | 1/2 | 1 | 1/2 | 1/2 | 1/4 | 1/4 | 1/2 | 2 | 1/4 | 1/4 | 1/4 |
| Hour | $20^{30}$ | $21^{00}$ | $21^{40}$ | $22^{55}$ | $19^{00}$ | $4^{00}$ | $9^{55}$ | $21^{55}$ | $20^{55}$ | $16^{20}$ | $17^{15}$ | $8^{15}$ | $20^{35}$ | $21^{25}$ |
| 1. *Bentheuphausia amblyops* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 2. *Thysanopoda obtusifrons* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 3. *Thysanopoda aequalis* | .. | .. | 1 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 4. *Thysanopoda acutifrons* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 5. *Thysanopoda microphth.* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 6. *Thysanopoda pectinata* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 7. *Meganyctiphanes norv.* | 4000 | 119 | 91 | 8150 | 130 | 6080 | 154 | 1103 | 3500 | 101 | 5900 | .. | .. | .. |
| 8. *Nyctiphanes couchii* | .. | 1 | .. | .. | .. | .. | .. | 1 | .. | .. | .. | 153 | 182 | 3 |
| 9. *Euphausia krohnii* | 112 | 34 | 25 | 256 | 2 | .. | 4 | 1 | .. | .. | .. | .. | .. | .. |
| 10. *Euphausia brevis* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 11. *Euphausia hemigibba* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 12. *Euphausia gibboides* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 13. *Thysanoessa inermis* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 14. *Thysanoessa longicaudata* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 15. *Thysanoessa gregaria* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 16. *Nematoscelis megalops* | .. | 16 | 19 | .. | 3 | .. | 5 | .. | .. | .. | 16 | .. | .. | .. |
| 17. *Nematoscelis tenella* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 18. *Nematoscelis microps* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 19. *Nematoscelis atlantica* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 20. *Nematobrachion boopis* | .. | 6 | 25 | .. | 4 | .. | 29 | .. | .. | .. | .. | .. | .. | .. |
| 21. *Nematobrachion flexipes* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 22. *Stylocheiron carinatum* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 23. *Stylocheiron elongatum* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 24. *Stylocheiron longicorne* | .. | 6 | 4 | .. | .. | .. | 3 | .. | .. | .. | .. | .. | .. | .. |
| 25. *Stylocheiron suhmii* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 26. *Stylocheiron maximum* | .. | 5 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 27. *Stylocheiron abbreviatum* | .. | .. | .. | .. | .. | .. | 3 | .. | .. | .. | .. | .. | .. | .. |

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Summer 1910

| 231 | | | | | 232 | | | | 233 | 234 | | | 235 | 236 | 239 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $^9/_9$ | | | | | $^9/_9$ | | | | $^{10}/_9$ | $^{10}/_9$ | | | $^{11}/_9$ | $^{13}/_9$ | $^{15}/_9$ |
| 35°56′ N.<br>7°16′ W. | | | | | 36°28′ N.<br>9°06′ W. | | | | 36°49′ N.<br>9°15′ W. | 38°10′ N.<br>9°20′ W. | | | 38°38′ N.<br>9°25′ W. | 39°56′ N.<br>9°26′ W. | 43°02′ N.<br>9°25′ W. |
| > 950 | | | | | ca. 3500 | | | | 658 | 910 | | | 110 | > 100 | > 100 |
| Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 |
| 25 | 25 | 300 | 1200 | ? | 25 | 300 | 1000 | 2000 | 25 | 25 | 300 | 1000 | 25 | 25 | 25 |
| $^1/_2$ | $^1/_2$ | $^1/_2$ | $^1/_2$ | ? | $^1/_2$ | $^1/_2$ | $^1/_2$ | $^1/_2$ | $^1/_4$ | $^1/_2$ | $^1/_2$ | $^1/_2$ | $^1/_2$ | $^1/_2$ | $^1/_2$ |
| $3^{20}$ | $4^{05}$ | $1^{15}$ | $2^{15}$ | ? | $20^{50}$ | $21^{35}$ | $22^{35}$ | $23^{45}$ | $5^{05}$ | $21^{45}$ | $22^{30}$ | $23^{20}$ | $5^{00}$ | $23^{00}$ | $5^{10}$ |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | 1 | .. | .. | .. | .. | .. | .. | .. | .. |
| 3 | 62 | 4 | 8 | .. | 70 | 41 | .. | 9 | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | 1 | 6 | .. | .. | .. | 1 | .. | .. | 2 | 6 | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | 3 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 260 | 265 | 70 | 149 | .. | .. | 1 | 5580 | 51 | 25 | 885 | 714 | 203 | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 60 | 29800 | 874 |
| 43 | 360 | 50 | 63 | .. | 61 | 41 | .. | .. | 57 | 3 | 3 | 10 | .. | .. | .. |
| 29 | 235 | 8 | 18 | .. | 177 | 123 | 1 | 10 | 8 | .. | .. | .. | .. | .. | .. |
| 8 | .. | 8 | 10 | .. | 151 | 37 | 64 | .. | .. | .. | .. | 1 | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | 5 | .. | .. | 17 | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | 1 | .. | 2 | 21 | .. | 44 | 2 | .. | 3 | 7 | .. | .. | .. |
| .. | .. | 75 | 13 | .. | 1 | 23 | .. | .. | 1 | .. | 109 | 17 | .. | .. | .. |
| .. | .. | 12 | 2 | .. | .. | 45 | .. | 3 | .. | .. | .. | .. | .. | .. | .. |
| 1 | .. | .. | 20 | .. | .. | 30 | .. | 9 | 24 | .. | .. | 2 | .. | .. | .. |
| .. | .. | 150 | 96 | .. | .. | 146 | 48 | 18 | 13 | .. | 24 | 26 | .. | .. | .. |
| .. | .. | .. | 28 | .. | .. | .. | .. | 4 | .. | .. | 1 | 15 | .. | .. | .. |
| .. | .. | .. | 1 | .. | .. | 1 | .. | 1 | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | 1 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | 6 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | 1 | 24 | 25 | .. | .. | 39 | .. | .. | .. | .. | 65 | 82 | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | 1 | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | 3 | .. | .. | 2 | 16 | .. | .. | .. | 19 | 8 | .. | .. | .. |
| .. | .. | 20 | 18 | .. | .. | 52 | 2 | 10 | 1 | .. | 7 | 20 | .. | .. | .. |

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| 270 | 264 | | 265 | | 266 | | 267 | | 268 | | 269 | | 376 | 377 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $^{13}/_2$ | $^{19}/_3$ | | $^{20}/_3$ | | $^{21}/_3$ | | $^{22}/_3$ | | $^{24}/_3$ | | $^{24}/_3$ | | $^{22}/_7$ | $^{23}/_7$ |
| 47°01′ N.<br>19°03′ W. | 38°14′ N.<br>24°35′ W. | | 39°22′ N.<br>22°49′ W. | | 40°47′ N.<br>21°10′ W. | | 42°37′ N.<br>18°06′ W. | | 45°44′ N.<br>13°20′ W. | | 46°44′ N.<br>11°20′ W. | | 34°41′ N.<br>16°14′ W. | 31°23′ N.<br>18°08′ W. |
| > 4200 | > 3200 | | > 5400 | | > 4300 | | > 4500 | | > 4500 | | > 4700 | | > 3500 | > 4300 |
| S. 150 | S. 150 | S. 100 | S. 150 | S. 100 | S. 150 | S. 100 | S. 150 | S. 100 | S. 150 | S. 100 | S. 150 | S. 100 | S. 200 | S. 200 |
| 116 | 25 | 47 | 25 | 47 | 25 | 47 | 25 | 47 | 25 | 47 | 25 | 47 | 15 | 15 |
| $^{33}/_{60}$ | $^1/_2$ | $^1/_2$ | $^1/_2$ | $^1/_2$ | $^1/_2$ | $^1/_2$ | $^1/_2$ | $^1/_2$ | $^1/_2$ | $^1/_2$ | $^1/_2$ | $^1/_2$ | $^1/_2$ | $^1/_2$ |
| $22^{05}$ | $19^{00}$ | $19^{00}$ | $19^{00}$ | $19^{00}$ | $19^{00}$ | $19^{00}$ | $19^{00}$ | $19^{00}$ | $4^{30}$ | $4^{30}$ | $19^{30}$ | $19^{30}$ | $8^{10}$ | $20^{05}$ |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | 1 | .. | .. | .. | .. | .. | .. | .. | .. | 242 | 2 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | 2 | .. | .. | .. | 39 | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 59 | 800 | 500 | { 700 | 952 | 145 | 684 | 3 | 319 | 10 | 104 | 364 | 119 | 195 | .. |
| .. | 32 | 9 | | 68 | 15 | .. | .. | .. | .. | .. | .. | .. | 1153 | 31 |
| .. | 16 | 5 | 8 | 10 | 1 | 4 | .. | .. | .. | .. | .. | .. | 53 | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | 8 | .. | .. | .. | 14 | .. | .. |
| .. | .. | .. | 14 | 65 | 8 | 190 | .. | .. | .. | .. | .. | .. | .. | .. |
| 1 | .. | .. | .. | 1 | .. | .. | .. | .. | .. | .. | .. | 1 | 3 | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | 1 | .. | .. | .. | .. | .. | .. | .. | .. | 338 | 2 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | 3 | .. | 1 | .. | 4 | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | 1 | 5 | .. | .. | .. | .. | .. | .. | .. | .. | 3 | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 4 | 1 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | 4 | .. | .. | .. | .. | .. | .. | .. | .. | 1 | .. |

Table I

Mediterranean,

| Station | 10 | | | | | 11 | | | | 12 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | $^{15}/_{12}$ 08 | | | | | $^{16}/_{12}$ 08 | | | | $^{19}/_{12}$ 08 | | |
| Position | 37°21′ N.<br>16°15′ E. | | | | | 36°57′ N.<br>18°16′ E. | | | | 39°34′ N.<br>17°17′ E. | | |
| Depth in metres | > 2100 | | | | | > 3700 | | | | 1060 | | |
| Trawl or net | Y. 200 | Y. 200 | C. 130 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 |
| Length of wire in metres | 25 | 65 | 400 | 600 | 1200 | 25 | 65 | 300 | 1000 | 65 | 300 | 1000 |
| Duration of haul in hours | 1 | 1 | $^{1}/_{2}$ | 1 | 1 | 1 | 1 | 2 | 3 | $^{1}/_{2}$ | 1 | $^{3}/_{4}$ |
| Hour | $5^{00}$ | $6^{10}$ | $8^{00}$ | $15^{45}$ | $9^{30}$ | $4^{00}$ | $5^{25}$ | $7^{00}$ | $9^{30}$ | $13^{00}$ | $11^{40}$ | $14^{15}$ |
| 3. *Thysanopoda aequalis* | 10 | 5 | . | 338 | 157 | 61 | 90 | 100 | 628 | .. | .. | 89 |
| 7. *Meganyctiphanes norvegica* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 1 |
| 8. *Nyctiphanes couchii* | | . | 1 | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 9. *Euphausia krohnii* | 64 | 13 | | 63 | 11 | 27 | 14 | .. | 24 | .. | .. | 60 |
| 10. *Euphausia brevis* | 1400 | 260 | 7 | 159 | 14 | 321 | 139 | .. | 79 | .. | .. | 6 |
| 11. *Euphausia hemigibba* | 600 | 40 | 3 | 450 | 51 | 1500 | 870 | 32 | 533 | .. | .. | 15 |
| 15. *Thysanoessa gregaria* | .. | . | . | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 16. *Nematoscelis megalops* | .. | 12 | | 2 | 25 | .. | 2 | .. | 12 | .. | .. | 135 |
| 19. *Nematoscelis atlantica* | .. | 1 | . | 17 | 57 | .. | 1 | 40 | 272 | .. | .. | 27 |
| 24. *Stylocheiron longicorne* | .. | | 11 | 30 | 7 | .. | .. | 45 | 6 | .. | 65 | 19 |
| 25. *Stylocheiron suhmii* | 100 | 89 | 45 | 20 | 6 | 275 | 215 | 4 | 12 | 10 | .. | .. |
| 26. *Stylocheiron maximum* | .. | | | 1 | 4 | 1 | .. | .. | .. | .. | .. | 1 |
| 27. *Stylocheiron abbreviatum* | .. | 1 | 24 | 5 | 6 | 3 | 3 | 20 | 36 | 6 | 7 | 4 |

Table I

Mediterranean,

| Station | 22 | | 23 | 24 | | | | | 25 | 26 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | $^{7}/_{1}$ 09 | | $^{15}/_{1}$ 09 | $^{16}/_{1}$ 09 | | | | | $^{17}/_{1}$ 09 | $^{18-19}/_{1}$ 09 | | |
| Position | 38°50′ N.<br>15°18′ E. | | 40°34′ N.<br>13° 24′ E. | 40°14′ N.<br>12°23′ E. | | | | | 40°34′ N.<br>13°24′ E. | 40°10′ N.<br>13°59′ E. | | |
| Depth in metres | > 750 | | > 1800 | > 3700 | | | | | > 1800 | 560 | | |
| Trawl or net | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 |
| Length of wire in metres | 25 | 200 | 25 | 25 | 65 | 300 | 600 | 1600 | 300 | 25 | 65 | 150 |
| Duration of haul in hours | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | 1 | 1 | 1 | 2 | 1 | 3 |
| Hour | $20^{00}$ | $20^{45}$ | $23^{00}$ | $22^{00}$ | $7^{00}$ | $21^{10}$ | $14^{10}$ | $23^{15}$ | $17^{40}$ | $4^{20}$ | $0^{45}$ | $0^{50}$ |
| 3. *Thysanopoda aequalis* | 26 | 220 | 90 | 150 | 400 | 200 | .. | 92 | 240 | 48 | 28 | 163 |
| 7. *Meganyctiphanes norvegica* | .. | .. | 3 | 6 | 1 | 1 | .. | .. | 1 | 3 | 48 | 46 |
| 8. *Nyctiphanes couchii* | | | .. | .. | .. | .. | .. | .. | .. | 1 | .. | 1 |
| 9. *Euphausia krohnii* | 12 | 6 | 40 | 6 | 380 | 24 | . | 4 | 32 | 120 | 119 | 223 |
| 10. *Euphausia brevis* | 38 | 30 | 20 | 33 | 450 | .. | .. | 36 | 32 | 33 | .. | 33 |
| 11. *Euphausia hemigibba* | 4 | 80 | 40 | 77 | 360 | 24 | .. | 48 | 120 | 19 | 63 | 50 |
| 15. *Thysanoessa gregaria* | .. | .. | .. | .. | | . | .. | .. | .. | .. | .. | .. |
| 16. *Nematoscelis megalops* | .. | .. | .. | . | ... | 20 | .. | 16 | 12 | 1 | 14 | 3 |
| 19. *Nematoscelis atlantica* | | | | 2 | . | 32 | .. | 16 | 47 | .. | 21 | 3 |
| 24. *Stylocheiron longicorne* | .. | .. | .. | .. | | 4 | 8 | 8 | 24 | .. | 28 | 2 |
| 25. *Stylocheiron suhmii* | .. | 2 | .. | | . | .. | .. | .. | .. | 3 | .. | 1 |
| 26. *Stylocheiron maximum* | .. | .. | .. | | | 4 | 6 | .. | .. | .. | .. | .. |
| 27. *Stylocheiron abbreviatum* | .. | 9 | .. | .. | | 28 | 1 | 12 | .. | 2 | 7 | 4 |

(continued)

Winter 1908—1909

| 13 | | | | 14 | | | 15 | | | 18 | | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $^{10}/_{12}$ 08<br>39°43′ N.<br>17°30′ E. | | | | $^{11}/_{12}$ 08<br>41°24′ N.<br>17°15′ E. | | | $^{23}/_{12}$ 08<br>40°04′ N.<br>19°00′ E. | | | $^{30}/_{12}$ 08<br>37°51′ N.<br>23°14′ E. | | $^{8}/_{1}$ 09<br>37°48′ N.<br>15°40′ E. | $^{9}/_{1}$ 09<br>37°51′ N.<br>15°21′ E. |
| > 1200 | | | | 1125 | | | 1125 | | 1000 | 220 | | > 1300 | > 500 |
| Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 |
| 15 | 65 | 300 | 1000 | 65 | 300 | 1000 | 25 | 65 | 1400 | 25 | 300 | 25 | 10 |
| 1 | 1 | 1 | 1 | 1 | 1 | $1^1/_2$ | 1 | 1 | 1 | 1 | 1 | 1 | $^1/_2$ |
| $22^{15}$ | $20^{50}$ | $17^{45}$ | $19^{00}$ | $5^{00}$ | $6^{40}$ | $8^{40}$ | $2^{40}$ | $1^{30}$ | $5^{20}/8^{00}$ | $19^{00}$ | $21^{40}$ | $1^{10}$ | $11^{50}$ |
| .. | 64 | 78 | 36 | 28 | 23 | 105 | 25 | 40 | 47 | .. | .. | 37 | .. |
| 2335 | 99 | 3 | 16 | 328 | 8 | 8 | 12 | 70 | 4 | .. | 1 | .. | .. |
| .. | 1 | .. | 1 | 12 | 2 | 3 | 2 | .. | .. | 11 | .. | .. | .. |
| 2 | 35 | 12 | 4 | 925 | 120 | 358 | 71 | 221 | 16 | 90 | 12 | 59 | 8 |
| .. | 26 | 12 | 29 | 23 | 7 | | 23 | 30 | 2 | | 1 | 105 | 41 |
| 36 | 20 | 8 | .. | 50 | 7 | — | 16 | 100 | 9 | | | 140 | [illegible] |
| .. | .. | .. | .. | .. | | | | | | | | | |
| .. | 35 | 22 | 32 | 1 | 2 | 1369 | | 5 | 43 | 1 | 71 | | 1 |
| .. | .. | 9 | 28 | 1 | 9 | 53 | .. | .. | 4 | 2 | .. | .. | .. |
| .. | .. | 33 | 32 | | 102 | 74 | .. | 2 | 2 | 1 | 27 | .. | .. |
| .. | .. | 4 | . | 9 | 2 | | 3 | | | | | 9 | 1 |
| .. | .. | 5 | 20 | 1 | | 6 | .. | .. | 5 | .. | .. | .. | .. |
| .. | .. | 20 | 4 | . | 6 | | | | | | 8 | | |

(continued)

Winter 1908—1909

| | 27 | | 28 | | | | | | 29 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $^{19-20}/_{1}$ 09<br>40°58′ N.<br>13°19′ E. | | $^{19}/_{1}$ 09<br>40°53′ N.<br>13°13′ E. | | | | | | $^{26}/_{1}$ 09<br>40°47′ N.<br>17°55′ E. | | | |
| | 90 | | 600 | | | | | | 1550 | | | |
| Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 |
| 300 | 25 | 65 | 25 | 65 | 100 | 200 | 400 | 1000 | 65 | 200 | 600 | 1650 |
| 3 | 3 | 2 | 1 | 2 | 1 | $^1/_2$ | $^1/_2$ | 1 | $^1/_2$ | 1 | 1 | 1 |
| $6^{40}$ | $2^{30}$ | $6^{00}$ | $19^{40}$ | $23^{50}$ | $22^{00}$ | $21^{00}$ | $18^{40}$ | $17^{00}$ | $20^{40}$ | $19^{00}$ | $21^{50}$ | $11^{15}$ |
| 76 | 300 | 20 | 160 | 146 | 600 | 292 | 68 | 30 | 51 | 69 | 12 | 12 |
| 7 | 101 | 39 | 1 | 334 | 13 | 8 | 5 | 4 | 6 | 5 | .. | 5 |
| 1 | 6 | 1 | . | 1 | | | | | | | | |
| 107 | 530 | 542 | 80 | 359 | 1470 | 507 | 56 | 50 | 41 | 68 | 20 | 93 |
| 39 | 118 | 26 | | 41 | 60 | 89 | 9 | 10 | 58 | 53 | 16 | 14 |
| 46 | 300 | 36 | 120 | 126 | 340 | 117 | 30 | 25 | 20 | 100 | 28 | 44 |
| .. | .. | .. | .. | | .. | .. | .. | .. | .. | .. | .. | |
| 12 | .. | 10 | | 1 | | 7 | 28 | 30 | 1 | 2 | 60 | 25 |
| 4 | 4 | 1 | 10 | 1 | | | 1 | 15 | | 5 | 16 | 12 |
| 31 | 12 | 2 | | 7 | 15 | 13 | 11 | 3 | 1 | 10 | 60 | 13 |
| 1 | 4 | 1 | | 1 | 15 | 1 | 1 | | 2 | 9 | | |
| 2 | . | .. | | | | | 9 | 1 | | | 1 | 3 |
| 39 | 20 | 4 | . | 8 | 15 | 7 | 11 | 1 | 2 | 23 | 28 | 11 |

Table I

Mediterranean,

| Station | 30 | | 31 | | | | 33 | 34 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | $^{21}/_{1}$ 09 | | $^{22}/_{1}$ 09 | | | | $^{22}/_{1}$ 09 | $^{23}/_{1}$ 09 | | | | |
| Position | 41°15′ N.<br>11°55′ E. | | 41°44′ N.<br>10°52′ E. | | | | 43°04′ N.<br>9°35′ E. | 43°27′ N.<br>8°16′ E. | | | | |
| Depth in metres | > 1800 | | 1420 | | | | 150 | > 2000 | | | | |
| Trawl or net | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 |
| Length of wire in metres | 65 | 300 | 65 | 200 | 600 | 1400 | 65 | 25 | 65 | 200 | 25 | 100 |
| Duration of haul in hours | 1 | 1 | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | 1 | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | 1 | 1 |
| Hour | $5^{30}$ | $7^{10}$ | $4^{30}$ | $3^{50}$ | $3^{00}$ | $1^{20}$ | $18^{30}$ | $4^{35}$ | $5^{30}$ | $6^{35}$ | $21^{10}$ | $19^{55}$ |
| 3. *Thysanopoda aequalis* | 874 | 34 | 10 | 110 | 82 | 49 | 3 | 1 | 4 | 11 | 1 | 4 |
| 7. *Meganyctiphanes norvegica* | 40 | .. | 88 | 11 | 3 | 5 | 3 | 124 | 37 | 13 | 133 | 33 |
| 8. *Nyctiphanes couchii* | .. | ... | .. | 1 | .. | .. | 1 | .. | .. | .. | .. | .. |
| 9. *Euphausia krohnii* | 106 | 17 | 90 | 59 | 28 | 40 | 7 | 7 | 2 | 6 | 17 | 23 |
| 10. *Euphausia brevis* | 31 | 31 | 68 | 47 | 26 | 17 | .. | 3 | 4 | .. | .. | 8 |
| 11. *Euphausia hemigibba* | 248 | 14 | 24 | 76 | 35 | 44 | 1 | 13 | 4 | 5 | .. | 1 |
| 15. *Thysanoessa gregaria* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 16. *Nematoscelis megalops* | 8 | 2 | .. | 9 | 70 | 77 | .. | 19 | 34 | 180 | 11 | 200 |
| 19. *Nematoscelis atlantica* | .. | 6 | .. | 1 | 2 | 25 | .. | .. | 1 | .. | .. | .. |
| 24. *Stylocheiron longicorne* | 13 | 33 | 3 | 43 | 68 | 42 | .. | 19 | 19 | 56 | .. | .. |
| 25. *Stylocheiron suhmii* | 1 | 1 | .. | 1 | .. | 1 | 2 | .. | .. | .. | .. | .. |
| 26. *Stylocheiron maximum* | .. | .. | .. | .. | 4 | 3 | .. | .. | .. | .. | .. | .. |
| 27. *Stylocheiron abbreviatum* | 1 | 9 | .. | 11 | 5 | 4 | .. | .. | 1 | .. | .. | .. |

Table I

Mediterranean,

| Station | 40 | 42 | 43 | 45 | | 46 | | | 47 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | $^{1}/_{2}$ 09 | $^{2}/_{2}$ 09 | $^{3}/_{2}$ 09 | $^{6-7}/_{2}$ 09 | | $^{7}/_{2}$ 09 | | | $^{10}/_{2}$ 09 | | | |
| Position | 39°10′ N.<br>9°40′ E. | 38°58′ N.<br>9°37′ E. | 38°14′ N.<br>8°42′ E. | 37°28′ N.<br>8°18′ E. | | 37°17′ N.<br>6°00′ E. | | | 36°55′ N.<br>3°12′ E. | | | |
| Depth in metres | 235 | 1120 | > 2000 | > 2150 | | > 1930 | | | > 2000 | | | |
| Trawl or net | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 |
| Length of wire in metres | 65 | 300 | 65 | 65 | 300 | 65 | 300 | 600 | 65 | 300 | 25 | 65 |
| Duration of haul in hours | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ |
| Hour | $21^{30}$ | $21^{40}$ | $6^{15}$ | $0^{15}$ | $23^{35}$ | $20^{20}$ | $19^{30}$ | $18^{35}$ | $22^{20}$ | $23^{05}$ | $1^{20}$ | $2^{00}$ |
| 3. *Thysanopoda aequalis* | 21 | 140 | 152 | 25 | 179 | 60 | 40 | 51 | 2 | .. | 10 | 7 |
| 7. *Meganyctiphanes norvegica* | .. | 2 | 1 | .. | .. | .. | .. | .. | .. | .. | 1 | 1 |
| 8. *Nyctiphanes couchii* | .. | .. | .. | .. | .. | .. | .. | .. | 1 | .. | .. | .. |
| 9. *Euphausia krohnii* | 325 | 30 | 196 | 35 | 5 | 110 | 180 | 55 | 750 | 225 | 500 | 232 |
| 10. *Euphausia brevis* | 11 | 20 | 72 | 60 | 5 | 35 | 32 | 13 | 31 | 45 | .. | 4 |
| 11. *Euphausia hemigibba* | 3 | 70 | 48 | 68 | 56 | 150 | 32 | 10 | 35 | 90 | 30 | 3 |
| 15. *Thysanoessa gregaria* | .. | .. | .. | .. | .. | .. | .. | .. | .. | 36 | .. | .. |
| 16. *Nematoscelis megalops* | 1 | 30 | 104 | 24 | 57 | 15 | 160 | 151 | 5 | 470 | 25 | 110 |
| 19. *Nematoscelis atlantica* | .. | 4 | 4 | .. | 10 | .. | 50 | 30 | .. | .. | .. | .. |
| 24 *Stylocheiron longicorne* | .. | 65 | 16 | .. | 39 | 1 | 175 | 41 | .. | 54 | .. | .. |
| 25. *Stylocheiron suhmii* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 26. *Stylocheiron maximum* | .. | .. | .. | .. | .. | .. | .. | 2 | .. | .. | .. | .. |
| 27. *Stylocheiron abbreviatum* | .. | 25 | .. | .. | 42 | .. | 140 | 20 | .. | 10 | .. | .. |

continued)

908—1909

| 35 | | | | | | 36 | | 38 | | 39 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $^{28-29}/_1$ 09 | | | | | | $^{30}/_1$ 09 | | $^{31}/_1$ 09 | | $^1/_2$ 09 | | | |
| 43°36′ N.<br>7°36′ E. | | | | | | 42°49′ N.<br>6°54′ E. | | 40°45′ N.<br>9°50′ E. | | 39°41′ N.<br>10°02′ E. | | | |
| > 2000 | | | | | | > 2000 | | 105 | | 1750 | | | |
| Y. 200 | Y. 200 | S. 100 | S. 100 | Y. 200 | C. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 |
| 200 | 300 | 700 | 1000 | 1600 | 2500 | 65 | 300 | 65 | 150 | 25 | 65 | 300 | 1000 |
| 1 | 2 | 2 | 2 | 2 | $1^1/_2$ | 1 | 1 | $^1/_2$ | $^1/_2$ | 1 | 1 | 1 | 2 |
| $18^{40}$ | $21^{40}$ | $11^{35}$ | $11^{35}$ | $11^{35}$ | $15^{45}$ | $5^{35}$ | $6^{50}$ | $18^{30}$ | $20^{20}$ | $5^{00}$ | $6^{10}$ | $7^{20}$ | $0^{30}$ |
| 36 | 11 | 28 | 3 | 5 | 2 | 7 | 2 | .. | .. | 524 | 2 | 1 | 148 |
| 8 | 15 | .. | .. | .. | .. | 255 | 35 | .. | 16 | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | 7 | .. | .. | .. | .. | .. |
| 16 | 17 | 4 | .. | 2 | 2 | 26 | 20 | .. | 40 | 28 | 1 | 1 | 218 |
| 4 | 2 | 1 | .. | .. | .. | 1 | 2 | .. | .. | 74 | 14 | 84 | 260 |
| 16 | 9 | 9 | .. | 5 | 4 | 11 | 1 | .. | .. | 150 | 1 | 1 | 167 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 108 | .. | 14 | 4 | 17 | 12 | 48 | 37 | .. | 3 | .. | 1 | 12 | 4 |
| .. | .. | 1 | 1 | 1 | 1 | .. | .. | .. | .. | .. | 2 | 5 | 14 |
| 36 | .. | 11 | 5 | 28 | 8 | 1 | 23 | .. | .. | .. | 1 | 41 | 23 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | 1 | 3 | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | 1 | 1 | .. | 2 | .. | .. | .. | 1 | .. | .. | 2 | 36 | 28 |

(continued)

1908—1909

| 50 | | | 51 | 52 | 53 | 55 | 57 | | 58 | 59 | | | | 61 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $^{17}/_2$ 09 | | | $^{18}/_2$ 09 | $^{18}/_2$ 09 | $^{18}/_2$ 09 | $^{19}/_2$ 09 | $^{20}/_2$ 09 | | $^{20}/_2$ 09 | $^{21}/_2$ 09 | | | | $^{21}/_2$ 09 |
| 37°02′ N.<br>1°17′ E. | | | 36°27′ N.<br>0°37′ W. | 35°55′ N.<br>1°02′ W. | 36°13′ N.<br>1°28′ W. | 36°46′ N.<br>2°18′ W. | 36°40′ N.<br>3°30′ W. | | 36°36′ N.<br>4°24′ W. | 36°02′ N.<br>4°24′ W. | | | | 35°57′ N.<br>5°35′ W. |
| > 2000 | | | >2000 | > 2000 | > 2000 | 75 | 105 | | 85 | 1260 | | | | 740 |
| Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | C. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 |
| 300 | 600 | 1600 | 300 | 300 | 2600 | 65 | 25 | 200 | 100 | 25 | 100 | 500 | 1200 | 600 |
| $^1/_2$ | $^1/_2$ | 1 | $^1/_2$ | $^1/_2$ | $1^1/_2$ | 1 | $^1/_2$ | $^1/_2$ | $^1/_2$ | $^1/_2$ | $^1/_2$ | $^1/_2$ | 1 | 1 |
| $3^{35}$ | $4^{10}$ | $5^{30}$ | $0^{50}$ | $7^{25}$ | $17^{15}$ | $7^{40}$ | $5^{45}$ | $6^{35}$ | $14^{00}$ | $0^{10}$ | $1^{00}$ | $1^{40}$ | $2^{40}$ | $15^{25}$ |
| 17 | 7 | 3 | 12 | .. | .. | .. | .. | .. | .. | .. | .. | 1 | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | 2 | .. | .. | .. | .. | .. | .. | 2 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | 8 | .. | .. | .. | .. | 4 |
| 116 | 21 | 21 | 160 | 25 | 18 | 71 | 600 | 220 | 6 | 500 | 400 | 800 | cc. | 1000 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | 2 | 2 | 12 | .. | 1 | .. | .. | .. | .. | .. | .. | 1 | .. | .. |
| .. | 1 | .. | 35 | 2 | .. | .. | .. | 16 | 21 | .. | .. | 1 | .. | .. |
| 80 | 42 | 50 | 210 | 17 | 8 | 52 | 11 | 236 | 52 | .. | 1 | 630 | c. | 420 |
| .. | 6 | 4 | .. | .. | 3 | .. | .. | .. | .. | .. | .. | 4 | .. | .. |
| 29 | 32 | 28 | 95 | 26 | 3 | .. | 1 | 136 | 15 | .. | .. | 253 | r. | 4 |
| .. | .. | .. | .. | .. | 1 | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 1 | 2 | 1 | .. | .. | .. | .. | .. | .. | .. | .. | .. | 1 | .. | 1 |
| .. | .. | 1 | .. | 1 | .. | .. | .. | 16 | .. | .. | .. | 2 | .. | .. |

Table I

Mediterranean,

| Station | 99 | | 104 | 106 | | | 107 | | | 108 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | $^{23\text{-}24}/_{6}$ | | $^{24}/_{6}$ | $^{25}/_{6}$ | | | $^{25}/_{6}$ | | | $^{25\text{-}26}/_{6}$ | | | |
| Position | 36°02′ N.<br>5°16′ W. | | 36°37′ N.<br>2°04′ W. | 36°33′ N.<br>2°00′ W. | | | 36°18′ N.<br>1°14′ W. | | | 36°03′ N.<br>0°27′ W. | | | |
| Depth in metres | 750 | | 250 | ca. 1100 | | | ca. 2250 | | | > 2400 | | | |
| Trawl or net | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 |
| Length of wire in metres | 65 | 300 | 65 | 65 | 300 | 1200 | 65 | 300 | 2000 | 25 | 65 | 300 | 2000 |
| Duration of haul in hours | $^{1}/_{4}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | 1 | $^{1}/_{2}$ | $^{1}/_{2}$ | 1 | $^{1}/_{4}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | 1 |
| Hour | $0^{10}$ | $23^{25}$ | $18^{20}$ | $2^{30}$ | $1^{45}$ | $0^{30}$ | $9^{50}$ | $9^{05}$ | $7^{30}$ | $23^{55}$ | $23^{15}$ | $22^{30}$ | $0^{40}$ |
| 3. *Thysanopoda aequalis* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 7. *Meganyctiphanes norvegica* | 1 | .. | 1 | 4 | 3 | .. | .. | .. | .. | .. | .. | .. | 2 |
| 8. *Nyctiphanes couchii* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 9. *Euphausia krohnii* | 450 | 528 | 1 | 79 | 1440 | 409 | 1 | .. | 33 | 19 | 14 | 176 | 92 |
| 10. *Euphausia brevis* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 11. *Euphausia hemigibba* | .. | .. | .. | .. | 2 | .. | .. | .. | .. | .. | .. | 2 | .. |
| 15. *Thysanoessa gregaria* | .. | 7 | .. | .. | 4 | .. | .. | 10 | 2 | .. | .. | 3 | 4 |
| 16. *Nematoscelis megalops* | 13 | 636 | .. | 3 | 165 | 4253 | .. | 33 | 305 | .. | 1 | 105 | 681 |
| 19. *Nematoscelis atlantica* | .. | .. | .. | .. | .. | .. | 11 | 1 | 9 | .. | .. | .. | 16 |
| 24. *Stylocheiron longicorne* | .. | .. | .. | .. | 16 | 133 | .. | 49 | 11 | .. | .. | 1 | 62 |
| 25. *Stylocheiron suhmii* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 26. *Stylocheiron maximum* | .. | .. | .. | .. | .. | .. | .. | 2 | 1 | .. | .. | .. | 2 |
| 27. *Stylocheiron abbreviatum* | .. | .. | .. | .. | .. | .. | .. | .. | 1 | .. | .. | .. | 1 |

Table I

Mediterranean,

| Station | 122 | | 123 | | | | 125 | | 126 | | 129 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | $^{2}/_{7}$ | | $^{3}/_{7}$ | | | | $^{9}/_{7}$ | | $^{10}/_{7}$ | | $^{12}/_{7}$ | | | |
| Position | 43°50′ N.<br>8°34′ E. | | 44°14′ N.<br>8°55′ E. | | | | 43°54′ N.<br>9°13′ E. | | 42°43′ N.<br>9°50′ E. | | 40°05′ N.<br>11°31′ E. | | | |
| Depth in metres | 1285 | | ca. 700 | | | | 1082 | | 588 | | 3420 | | | |
| Trawl or net | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y.200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | P. 100 | Y. 200 | Y. 200 | Y. 200 |
| Length of wire in metres | 600 | 1200 | 10 | 25 | 65 | 300 | 25 | 300 | 25 | 300 | Surf. | 25 | 300 | 600 |
| Duration of haul in hours | 1 | $^{1}/_{2}$ | $^{1}/_{4}$ | $^{1}/_{4}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{6}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ |
| Hour | $10^{00}$ | $17^{30}$ | $2^{30}$ | $1^{50}$ | $0^{55}$ | $0^{05}$ | $22^{30}$ | $21^{45}$ | $22^{10}$ | $21^{30}$ | $3^{10}$ | $3^{00}$ | $3^{40}$ | $20^{00}$ |
| 3. *Thysanopoda aequalis* | .. | 3 | .. | 11 | 3 | 1 | .. | 10 | 18 | 1 | .. | 102 | 613 | 149 |
| 7. *Meganyctiphanes norvegica* | .. | 81 | .. | .. | 4 | 11 | 2872 | 228 | 57 | 22 | .. | .. | 7 | .. |
| 8. *Nyctiphanes couchii* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 9. *Euphausia krohnii* | .. | 78 | 114 | 150 | 144 | 62 | .. | 42 | 675 | 181 | 3 | 14 | 113 | 83 |
| 10. *Euphausia brevis* | .. | 7 | 28 | | 6 | .. | 16 | 2 | .. | .. | .. | 215 | 53 | 45 |
| 11. *Euphausia hemigibba* | .. | 11 | 2 | 19 | 36 | 17 | .. | 21 | 5 | 3 | .. | 68 | 862 | 213 |
| 15. *Thysanoessa gregaria* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 16. *Nematoscelis megalops* | 8 | 210 | .. | .. | 6 | 67 | .. | 570 | 1 | 422 | .. | 3 | 134 | 187 |
| 19. *Nematoscelis atlantica* | .. | 5 | .. | 5 | .. | 5 | .. | 15 | 23 | 47 | .. | | 7 | 82 |
| 24. *Stylocheiron longicorne* | 48 | 21 | .. | .. | 1 | 21 | .. | 35 | .. | 82 | .. | .. | 42 | .. |
| 25. *Stylocheiron suhmii* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 1 |
| 26. *Stylocheiron maximum* | 13 | 8 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 12 |
| 27. *Stylocheiron abbreviatum* | 3 | 8 | .. | .. | .. | 9 | .. | 13 | .. | 46 | .. | .. | 159 | 66 |

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| 112 | | | 113 | 115 | | | | 116 | | | 118 | | | | 120 | 121 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $^{27}/_6$ | | | $^{28}/_6$ | $^{28\text{-}29}/_6$ | | | | $^{29\text{-}30}/_6$ | | | $^{30}/_6$—$^1/_7$ | | | | $^1/_7$ | $^2/_7$ |
| 36°56′ N.<br>2°15′ E. | | | 36°53′ N.<br>3°09′ E. | 38°17′ N.<br>4°11′ E. | | | | 39°27′ N.<br>5°26′ E. | | | 41°00′ N.<br>6°43′ E. | | | | 42°31′ N.<br>7°41′ E. | 43°08′ N.<br>8°05′ E. |
| 2700 | | | 815 | 2800 | | | | 2860 | | | > 2700 | | | | ca. 2700 | > 2500 |
| Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 |
| 25 | 65 | 300 | 300 | 25 | 65 | 300 | 2000 | 25 | 300 | 300 | 25 | 65 | 300 | 300 | 300 | 25 |
| $^1/_4$ | $^1/_4$ | $^1/_2$ | $^1/_2$ | $^1/_4$ | $^1/_4$ | $^1/_2$ | 1 | $^1/_4$ | $^1/_2$ | $^1/_2$ | $^1/_4$ | $^1/_2$ | $^1/_2$ | $^1/_2$ | $^1/_2$ | $^1/_2$ |
| $1^{30}$ | $1^{05}$ | $0^{15}$ | $3^{25}$ | $1^{40}$ | $1^{20}$ | $23^{20}$ | $0^{30}$ | $3^{00}$ | $16^{05}$ | $1^{40}$ | $0^{20}$ | $23^{35}$ | $17^{55}$ | $22^{55}$ | $20^{50}$ | $3^{05}$ |
| 1 | .. | 18 | 10 | 1 | 1 | 48 | 5 | 265 | .. | 46 | 145 | 27 | .. | 21 | 8 | .. |
| .. | .. | 2 | .. | .. | .. | 106 | 5 | 2 | .. | 660 | 62 | 354 | 74 | 5 | 45 | 1 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 538 | 600 | 132 | 4000 | 348 | 510 | 400 | 355 | 97 | .. | 35 | 246 | 218 | .. | 45 | 40 | .. |
| .. | .. | .. | .. | 14 | 5 | 5 | 9 | 12 | .. | 10 | 7 | 5 | .. | 4 | 16 | 1 |
| .. | .. | 22 | .. | .. | .. | 50 | 24 | 55 | 1 | 64 | 650 | 71 | .. | 40 | 24 | 1 |
| .. | .. | 10 | 7 | .. | .. | 1 | .. | .. | .. | 1 | .. | .. | .. | .. | .. | .. |
| .. | 1 | 373 | 860 | .. | .. | 308 | 518 | .. | 17 | 383 | 3 | 85 | 28 | 417 | 712 | 11 |
| 10 | .. | 1 | 50 | .. | 2 | 17 | 78 | .. | .. | 142 | 20 | 5 | 5 | 182 | .. | 2 |
| .. | 1 | 6 | 14 | .. | 1 | 135 | 1 | .. | 83 | 181 | .. | 5 | 61 | 56 | 32 | 3 |
| .. | .. | .. | .. | .. | .. | .. | 1 | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | 10 | .. | .. | .. | 6 | .. | .. | .. | 2 | .. | .. | 5 | .. | 1 | .. |
| .. | 2 | 25 | 7 | .. | .. | 14 | 5 | .. | 5 | 37 | .. | .. | 34 | 44 | 16 | 1 |

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| | | 130 | 131 | | 132 | | | 133 | | | 134 | | 135 | 137 | 138 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $^{13}/_7$ | $^{13}/_7$ | | $^{14}/_7$ | | | $^{14}/_7$ | | | $^{15}/_7$ | | $^{16}/_7$ | $^{19}/_7$ | $^{19}/_7$ | | |
| | | 39°35′ N.<br>11°20′ E. | 38°36′ N.<br>11°00′ E. | | 38°57′ N.<br>9°47′ E. | | | 38°18′ N.<br>9°59′ E. | | | 37°37′ N.<br>10°17′ E. | | 37°17′ N.<br>10°28′ E. | 37°17′ N.<br>10°56′ E. | 37°37′ N.<br>11°25′ E. | | |
| | | > 3000 | 915 | | 1227 | | | 602 | | | 350 | 400 | 200 | 195 | 788 | | |
| Y. 200 | C. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 |
| 1000 | 3500 | 25 | 300 | 1000 | 25 | 300 | 600 | 25 | 300 | 600 | 25 | 300 | 25 | 250 | 25 | 300 | 1000 |
| 1 | 2 | $^1/_2$ | $^1/_2$ | 1 | $^1/_2$ | $^1/_2$ | $^1/_2$ | $^1/_2$ | $^1/_2$ | $^1/_2$ | $^1/_2$ | $^1/_2$ | $^1/_2$ | $^1/_2$ | $^1/_2$ | 1 | 1 |
| $4^{20}$ | $15^{00}$ | $0^{50}$ | $10^{35}$ | $10^{40}$ | $3^{05}$ | $3^{45}$ | $4^{50}$ | $23^{00}$ | $22^{15}$ | $21^{20}$ | $4^{50}$ | $5^{40}$ | $0^{55}$ | $9^{05}$ | $21^{50}$ | $21^{10}$ | $19^{10}$ |
| 252 | 11 | 555 | 1 | 112 | 10 | 150 | 3 | 20 | 35 | 22 | 3 | .. | .. | .. | 13 | 12 | 9 |
| 2 | .. | .. | .. | 16 | .. | 39 | .. | .. | 1 | .. | .. | .. | .. | .. | 1 | 166 | 31 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 42 | .. | 2 | 17 | 5 |
| 113 | 9 | 40 | .. | 980 | 16 | 148 | 1 | 20 | 24 | 20 | .. | .. | .. | .. | 5 | 61 | 39 |
| 30 | 3 | 80 | .. | 16 | 67 | 22 | 2 | 107 | 14 | 21 | .. | 1 | .. | 1 | 213 | 53 | 33 |
| 340 | 15 | 183 | .. | 1800 | 8 | 355 | 2 | 31 | 110 | 140 | .. | .. | .. | 4 | 4 | 133 | 92 |
| .. | .. | .. | 6 | .. | .. | .. | .. | .. | .. | 5 | .. | 1 | .. | 2 | .. | .. | 8 |
| 102 | 24 | 1 | .. | 910 | .. | 156 | 14 | 4 | 1300 | 365 | .. | 8 | .. | 6 | .. | 164 | 1600 |
| 63 | 14 | 3 | .. | 370 | .. | 10 | 4 | 5 | 65 | 79 | 4 | 2 | .. | .. | .. | .. | 114 |
| 14 | 1 | .. | 25 | 8 | .. | 135 | 50 | 3 | 132 | 131 | .. | 19 | .. | 4 | 1 | 7 | 61 |
| .. | .. | 1 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 2 | .. | .. |
| 3 | .. | .. | .. | 8 | .. | .. | .. | .. | .. | 12 | .. | .. | .. | .. | .. | .. | 1 |
| 26 | 14 | .. | 164 | 8 | .. | 253 | 49 | .. | 115 | 60 | .. | 28 | .. | 12 | .. | 10 | 73 |

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| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station | 139 | | 141 | 143 | | | 144 | | | | 145 | | 147 | | |
| Date | $^{20}/_{7}$ | | $^{20}/_{7}$ | $^{23}/_{7}$ | | | $^{24}/_{7}$ | | | | $^{25}/_{7}$ | | $^{25\text{-}26}/_{7}$ | | |
| Position | 37°57′ N.<br>11°54′ E. | | 36°42′ N.<br>13°34′ E. | 35°18′ N.<br>16°25′ E. | | | 34°31′ N.<br>18°40′ E. | | | | 32°38′ N.<br>19°02′ E. | | 31°35′ N.<br>19°02′ E. | | |
| Depth in metres | 680 | 530 | 530 | 1842 | | | 3340 | | | | 3340 | 1925 | 993 | | |
| Trawl or net | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | C. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 2 |
| Length of wire in metres | 25 | 300 | 25 | 25 | 300 | 1000 | 25 | 300 | 2000 | 4000 | 25 | 300 | 25 | 300 | 10 |
| Duration of haul in hours | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{4}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | 1 | $^{1}/_{2}$ | $^{1}/_{2}$ | 1 | 1 | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | 1 |
| Hour | $1^{40}$ | $2^{25}$ | $22^{35}$ | $1^{30}$ | $0^{30}$ | $2^{00}$ | $2^{00}$ | $2^{45}$ | $3^{45}$ | $6^{20}$ | $3^{30}$ | $4^{10}$ | $23^{35}$ | $0^{20}$ | 1 |
| 3. *Thysanopoda aequalis* | 13 | 9 | 4 | 630 | 116 | 55 | 263 | 121 | 38 | 8 | 18 | 22 | 160 | 33 | 1 |
| 7. *Meganyctiphanes norvegica* | .. | 1 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | . |
| 8. *Nyctiphanes couchii* | 58 | 11 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | . |
| 9. *Euphausia krohnii* | 78 | 127 | .. | 7 | 23 | 23 | .. | .. | .. | .. | .. | 2 | .. | .. | |
| 10. *Euphausia brevis* | 78 | 8 | 14 | 183 | 10 | .. | 28 | 14 | 5 | .. | 43 | 9 | 356 | 10 | |
| 11. *Euphausia hemigibba* | 91 | 204 | 1 | 110 | 114 | 36 | 157 | 119 | 56 | 1 | 42 | 111 | 222 | 75 | 2 |
| 15. *Thysanoessa gregaria* | .. | .. | .. | .. | 1 | 3 | .. | .. | .. | .. | .. | .. | .. | .. | . |
| 16. *Nematoscelis megalops* | 1 | 60 | .. | 1 | 112 | 59 | .. | .. | .. | .. | .. | .. | .. | 1 | . |
| 19. *Nematoscelis atlantica* | 2 | 59 | .. | 2 | 8 | 44 | 1 | 2 | 8 | 1 | .. | 4 | .. | 3 | 1 |
| 24. *Stylocheiron longicorne* | .. | 40 | .. | .. | 89 | 27 | 1 | 88 | 10 | .. | .. | 46 | 1 | 67 | 1 |
| 25. *Stylocheiron suhmii* | .. | .. | 1 | 5 | 2 | 2 | 140 | 24 | 9 | 1 | 16 | 20 | 5 | 20 | |
| 26. *Stylocheiron maximum* | .. | .. | .. | .. | 7 | 2 | .. | .. | 1 | .. | .. | .. | .. | .. | |
| 27. *Stylocheiron abbreviatum* | .. | 14 | .. | 1 | 128 | 52 | .. | 50 | 23 | 5 | .. | 59 | .. | 65 | 6 |

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| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station | 175 | | | | 176 | 179 | 181 | 182 | | | 183 | 184 | | | |
| Date | $^{11\text{-}12}/_{8}$ | | | | $^{12}/_{8}$ | $^{13}/_{8}$ | $^{13}/_{8}$ | $^{14}/_{8}$ | | | $^{16}/_{8}$ | $^{17}/_{8}$ | | | |
| Position | 40°48′ N.<br>27°59′ E. | | | | 40°45′ N.<br>27°43′ E. | 40°02′ N.<br>25°55′ E. | 38°49′ N.<br>25°09′ E. | 38°13′ N.<br>24°48′ E. | | | 37°52′ N.<br>23°09′ E. | 38°10′ N.<br>22°33′ E. | | | |
| Depth in metres | 1103 | | | | > 500 | 85 | 255 | 500 | | | 233 | 842 | | | |
| Trawl or net | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 2 |
| Length of wire in metres | 35 | 100 | 400 | 1200 | 65 | 65 | 300 | 10 | 65 | 600 | 300 | 10 | 65 | 1000 | 10 |
| Duration of haul in hours | $^{1}/_{4}$ | $^{1}/_{4}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{3}$ | $^{1}/_{4}$ | $^{1}/_{4}$ | $^{1}/_{2}$ | $^{1}/_{4}$ | $^{1}/_{4}$ | $^{1}/_{4}$ | $^{1}/_{2}$ | 1/ |
| Hour | $22^{15}$ | $22^{45}$ | $23^{20}$ | $0^{25}$ | $4^{00}$ | $2^{15}$ | $13^{25}$ | $23^{00}$ | $22^{30}$ | $23^{40}$ | $16^{45}$ | $1^{50}$ | $2^{15}$ | $2^{45}$ | 23 |
| 3. *Thysanopoda aequalis* | .. | .. | .. | .. | .. | .. | .. | 1 | 4 | 1 | .. | .. | .. | 1 | 20 |
| 7. *Meganyctiphanes norvegica* | 3 | 5 | 3 | .. | 12 | .. | .. | .. | .. | .. | .. | .. | .. | 1 | .. |
| 8. *Nyctiphanes couchii* | .. | .. | .. | .. | .. | 1 | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 9. *Euphausia krohnii* | .. | 82 | 28 | 37 | 172 | .. | .. | 200 | 170 | 46 | .. | 135 | 192 | 24 | |
| 10. *Euphausia brevis* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 3 |
| 11. *Euphausia hemigibba* | .. | .. | .. | .. | .. | .. | .. | 1 | 1 | 1 | .. | .. | .. | .. | .. |
| 15. *Thysanoessa gregaria* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 16. *Nematoscelis megalops* | .. | 4 | 12 | 2 | .. | .. | .. | .. | 1 | 12 | 51 | .. | .. | 1 | . |
| 19. *Nematoscelis atlantica* | .. | .. | .. | .. | .. | .. | .. | .. | .. | 1 | .. | .. | .. | .. | .. |
| 24. *Stylocheiron longicorne* | .. | .. | .. | .. | .. | .. | 33 | .. | .. | 37 | 39 | .. | .. | 1 | |
| 25. *Stylocheiron suhmii* | .. | .. | .. | .. | .. | 43 | 15 | 2 | 177 | 46 | 31 | .. | .. | .. | |
| 26. *Stylocheiron maximum* | .. | .. | .. | .. | .. | .. | .. | .. | .. | 18 | .. | .. | .. | 1 | .. |
| 27. *Stylocheiron abbreviatum* | .. | .. | .. | .. | .. | 1 | 13 | .. | 1 | 122 | 8 | .. | .. | .. | .. |

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| 152 | | | 154 | 156 | | | | 158 | 160 | | | | 161 | 163 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $^{27-28}/_{7}$ | | | $^{29}/_{7}$ | $^{30}/_{7}$ | | | | $^{31}/_{7}$ | $^{1}/_{8}$ | | | | $^{2}/_{8}$ | $^{3}/_{8}$ | | |
| 33°11′ N.<br>21°44′ E. | | | 32°10′ N.<br>24°46′ E. | 32°16′ N.<br>26°03′ E. | | | | 34°23′ N.<br>27°57′ E. | 35°59′ N.<br>28°14′ E. | | | | 36°12′ N.<br>27°16′ E. | 37°52′ N.<br>26°22′ E. | | |
| > 2200 | | | 365 | ca. 3200 | | | | > 2000 | > 1000 | | | 2980 | > 1000 | 1170 | | |
| Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | C. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 |
| 25 | 300 | 1000 | 300 | 25 | 300 | 600 | 1000 | 300 | 25 | 300 | 1000 | 4000 | 25 | 25 | 200 | 1000 |
| $^{1}/_{4}$ | $^{1}/_{2}$ | 1 | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | 1 | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | 1 | 1 | $^{1}/_{2}$ | $^{1}/_{1}$ | $^{1}/_{4}$ | $^{1}/_{2}$ |
| $22^{50}$ | $23^{35}$ | $0^{30}$ | $4^{30}$ | $2^{15}$ | $3^{50}$ | $3^{00}$ | $0^{40}$ | $7^{30}$ | $2^{00}$ or $14^{20}$ | $2^{45}$ | $3^{35}$ | $15^{30}$ | $3^{00}$ | $1^{40}$ | $1^{05}$ | $0^{05}$ |
| 75 | 66 | 22 | .. | 80 | 128 | 76 | 65 | .. | 201 | 30 | 68 | 37 | 11 | 18 | 12 | 5 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 1 | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | 12 | 1 | .. | 1 | 10 | 20 | 9 | .. | .. | .. | .. | .. | 73 | 324 | 242 | 141 |
| 104 | 19 | 29 | .. | 43 | 15 | 9 | 16 | .. | 32 | 7 | 16 | 1 | 693 | 2 | .. | 2 |
| 18 | 272 | 42 | .. | 55 | 129 | 16 | 21 | .. | 38 | 86 | 84 | 122 | 11 | .. | 15 | 4 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 58 |
| .. | .. | 9 | .. | .. | 1 | 3 | 8 | 1 | .. | .. | 36 | 9 | .. | .. | 1 | 3 |
| .. | 128 | 11 | 10 | .. | 77 | 20 | 28 | 3 | 3 | 72 | 48 | 2 | .. | .. | 113 | 45 |
| 21 | 12 | 5 | 4 | 3 | 24 | 13 | 42 | 51 | .. | 33 | 28 | .. | 83 | 58 | 40 | 16 |
| .. | .. | .. | .. | .. | .. | .. | 1 | .. | .. | .. | 8 | 4 | .. | .. | .. | 5 |
| .. | 121 | 32 | 7 | .. | 20 | 11 | 19 | 114 | .. | 170 | 168 | 17 | .. | .. | 76 | 50 |

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| 186 | | | 187 | | 189 | | 190 | 192 | | | 193 | 194 | | | 195 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $^{17-18}/_{8}$ | | | $^{18}/_{8}$ | | $^{19}/_{8}$ | | $^{19}/_{8}$ | $^{20}/_{8}$ | | | $^{21}/_{8}$ | $^{21}/_{8}$ | | | $^{21}/_{8}$ | |
| 7°57′ N.<br>9°51′ E. | | | 37°54′ N.<br>18°02′ E. | | 37°44′ N.<br>15°58′ E. | | 37°51′ N.<br>15°19′ E. | 38°07′ N.<br>15°35′ E. | | | 38°15′ N.<br>15°39′ E. | 38°33′ N.<br>15°29′ E. | | | 39°02′ N.<br>14°55′ E. | |
| > 3000 | | | > 2500 | | < 2000 | | 360 | 652 | | | > 100 | 1140 | | | ca. 3160 | |
| Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 |
| 65 | 300 | 1200 | 300 | 1000 | 300 | 1000 | 25 | 25 | 300 | 600 | 10 | 10 | 25 | 1200 | 65 | 300 |
| $^{1}/_{4}$ | $^{1}/_{4}$ | $^{1}/_{2}$ | $^{1}/_{4}$ | $^{1}/_{2}$ | $^{1}/_{4}$ | $^{1}/_{2}$ | $^{1}/_{4}$ | $^{1}/_{4}$ | $^{1}/_{4}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{4}$ | $^{1}/_{4}$ | $^{1}/_{2}$ | $^{1}/_{4}$ | $^{1}/_{2}$ |
| $24^{00}$ | $20^{15}$ | $0^{45}$ | $0^{55}$ | $18^{40}$ | $8^{55}$ | $9^{30}$ | $20^{15}$ | $21^{40}$ | $22^{10}$ | $22^{50}$ | $0^{50}$ | $4^{30}$ | $5^{00}$ | $6^{00}$ | $18^{50}$ | $18^{10}$ |
| 9 | 153 | 157 | .. | 82 | .. | 212 | .. | 4 | 8 | 6 | 26 | 1 | 4 | 81 | .. | 10 |
| .. | 2 | .. | .. | 2 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 1 | 36 | 21 | .. | 1 | .. | 31 | 47 | 377 | 237 | 1550 | 24 | .. | .. | 30 | .. | .. |
| .. | 1 | 5 | .. | 15 | .. | 6 | .. | .. | .. | .. | 1 | .. | 47 | 14 | .. | .. |
| 9 | 380 | 240 | .. | 64 | .. | 106 | .. | .. | 2 | 3 | .. | .. | 3 | 167 | .. | 1 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 1 | .. | .. | .. | .. | .. |
| 4 | 12 | 53 | .. | 47 | .. | 50 | .. | 7 | 164 | 265 | .. | .. | .. | 73 | 1 | .. |
| .. | 4 | 12 | .. | 7 | .. | 21 | .. | .. | 8 | 26 | 2 | 38 | .. | 159 | 3 | 2 |
| .. | 39 | 15 | 15 | 17 | 46 | 3 | .. | .. | 64 | 76 | .. | .. | .. | 5 | .. | 23 |
| 1 | 30 | 32 | 30 | 24 | 32 | 7 | 6 | .. | .. | 1 | .. | .. | .. | .. | 1 | .. |
| .. | .. | 6 | .. | 9 | .. | 2 | .. | .. | 2 | 19 | .. | .. | .. | 1 | .. | .. |
| .. | 45 | 32 | 13 | 19 | 34 | 10 | .. | .. | 14 | 55 | .. | .. | .. | 30 | 1 | 53 |

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| Station | 196 | 197 | | 199 | | | 200 | 202 | 204 | | | | 205 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | $^{22}/_{8}$ | $^{24}/_{8}$ | | $^{25}/_{8}$ | | | $^{26}/_{8}$ | $^{26}/_{8}$ | $^{27}/_{8}$ | | | | $^{27}/_{8}$ | |
| Position | 39°59′ N.<br>14°31′ E. | 40°34′ N.<br>13°36′ E. | | 39°32′ N.<br>10°49′ E. | | | 39°18′ N.<br>10°11′ E. | 38°59′ N.<br>9°25′ E. | 38°52′ N.<br>7°43′ E. | | | | 39°16′ N.<br>5°52′ E. | |
| Depth in metres | > 600 | > 1000 | | ca. 2700 | | | > 2000 | 760 | > 1000 | | | | ca. 2860 | |
| Trawl or net | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 |
| Length of wire in metres | 25 | 25 | 300 | 25 | 300 | 1000 | 25 | 300 | 25 | 65 | 300 | 1000 | 25 | 25 |
| Duration of haul in hours | $^{1}/_{2}$ | $^{1}/_{4}$ | $^{1}/_{2}$ | $^{1}/_{4}$ | $^{1}/_{3}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{4}$ | $^{1}/_{4}$ | $^{1}/_{4}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | $^{1}/_{4}$ | $^{1}/_{4}$ |
| Hour | $2^{40}$ | $19^{45}$ | $19^{00}$ | $21^{00}$ | $21^{25}$ | $22^{10}$ | $3^{45}$ | $17^{05}$ | $4^{00}$ | $4^{30}$ | $5^{00}$ | $5^{45}$ | $19^{35}$ | $0^{30}$ |
| 3. *Thysanopoda aequalis* | 595 | 17 | 68 | 750 | 229 | 138 | 11 | 1 | 652 | 74 | 73 | 97 | 15 | 147 |
| 7. *Meganyctiphanes norvegica* | .. | .. | 11 | .. | 22 | 3 | .. | .. | .. | 2 | 14 | 16 | .. | .. |
| 8. *Nyctiphanes couchii* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 9. *Euphausia krohnii* | 1 | 16 | 238 | 6 | 160 | 20 | 4 | .. | 58 | 1100 | 376 | 456 | 5 | 20 |
| 10. *Euphausia brevis* | 309 | 128 | 3 | 173 | 160 | 71 | 283 | .. | 122 | 20 | 25 | 33 | 103 | 21 |
| 11. *Euphausia hemigibba* | 247 | .. | 48 | 203 | 430 | 137 | 26 | .. | 277 | 80 | 202 | 172 | 15 | 9 |
| 15. *Thysanoessa gregaria* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 16. *Nematoscelis megalops* | .. | .. | 57 | .. | 267 | 174 | .. | 2 | .. | 10 | 68 | 192 | .. | .. |
| 19. *Nematoscelis atlantica* | .. | .. | 16 | 2 | 50 | .. | 1 | .. | .. | .. | 20 | 76 | 1 | .. |
| 24. *Stylocheiron longicorne* | .. | .. | 35 | .. | 139 | 58 | 1 | 76 | .. | .. | 39 | 39 | .. | .. |
| 25. *Stylocheiron suhmii* | .. | .. | .. | .. | .. | .. | .. | .. | .. | 1 | .. | .. | .. | .. |
| 26. *Stylocheiron maximum* | .. | .. | 1 | .. | 2 | 8 | .. | .. | .. | .. | .. | 4 | .. | .. |
| 27. *Stylocheiron abbreviatum* | .. | .. | 11 | .. | 81 | 49 | .. | 28 | .. | 4 | 21 | 23 | .. | .. |

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| Station | 223 | | 224 | 225 | 228 | | 279 | 280 | 281 | | | | 282 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | $^{5}/_{9}$ | | $^{5}/_{9}$ | $^{6}/_{9}$ | $^{7}/_{9}$ | | $^{23}/_{2}$ 11 | $^{25}/_{2}$ 11 | $^{1}/_{3}$ 11 | | | | $^{8-9}/_{3}$ 11 | | |
| Position | 36°13′ N.<br>1°28′ W. | | 36°33′ N.<br>2°00′ W. | 36°35′ N.<br>3°00′ W. | 36°02′ N.<br>5°06′ W. | | 38°11.5′N.<br>15°36.5′E. | 38°11′ N.<br>15°36.5′E. | 38°15′ N.<br>15°37.5′ E. | | | | 38°12′ N.<br>15°37′ E. | | |
| Depth in metres | > 2000 | | > 950 | 200 | > 800 | | (350) | (230) | (200) | 5—8 | (200) | | (200) | | |
| Trawl or net | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | S. 100 | S. 100 | S. 100 | S. 100 | S. 100 | S. 100 | S. 100 | S. 100 | S. 100 |
| Length of wire in metres | 25 | 300 | 300 | 25 | 25 | 300 | 30 | 15 | 10 | 30 | 40 | 40 | 40 | 40 | 40 |
| Duration of haul in hours | $^{1}/_{4}$ | $^{1}/_{2}$ | $^{1}/_{4}$ | $^{1}/_{4}$ | $^{1}/_{2}$ | $^{1}/_{2}$ | 2 | 2 | 2 | 2 | 2 | 2 | $1^{1}/_{2}$ | 3 | $1^{2}/_{2}$ |
| Hour | $4^{35}$ | $4^{58}$ | $19^{20}$ | $3^{30}$ | $2^{40}$ | $1^{55}$ | $19^{00}$ | $17^{20}$ | $16^{55}$ | $15^{44}$ | $18^{10}$ | $19^{50}$ | $2^{00}$ | $22^{45}$ | $19^{15}$ |
| 3. *Thysanopoda aequalis* | .. | .. | .. | .. | .. | .. | larvae | .. | 2 | larvae | 1 | .. | juv. | .. | 1 |
| 7. *Meganyctiphanes norvegica* | .. | 1 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | juv. | .. | .. |
| 8. *Nyctiphanes couchii* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 9. *Euphausia krohnii* | 622 | 166 | 228 | 545 | 527 | 1400 | larvae | 1 | .. | .. | .. | .. | .. | juv. | 2 |
| 10. *Euphausia brevis* | .. | .. | .. | .. | .. | .. | | .. | .. | .. | .. | .. | .. | .. | .. |
| 11. *Euphausia hemigibba* | .. | .. | .. | .. | .. | .. | | 1 | .. | larvae | .. | .. | .. | juv. | 1 |
| 15. *Thysanoessa gregaria* | .. | 19 | 2 | .. | .. | 3 | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 16. *Nematoscelis megalops* | 2 | 617 | 11 | 1 | .. | 925 | .. | .. | .. | larvae | .. | c. | juv. | juv. | 12 |
| 19. *Nematoscelis atlantica* | .. | .. | 12 | .. | .. | .. | larvae | 3 | .. | larvae | 8 | .. | juv. | juv. | 7 |
| 24. *Stylocheiron longicorne* | 1 | 135 | 106 | .. | .. | 12 | .. | .. | .. | .. | .. | .. | juv. | ad. | 1 |
| 25. *Stylocheiron suhmii* | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | ad. | 1 |
| 26. *Stylocheiron maximum* | .. | 1 | 2 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 27. *Stylocheiron abbreviatum* | .. | 7 | .. | .. | .. | .. | .. | .. | 2 | larvae | .. | .. | juv. | juv. | 1 |

continued)

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| 206 | | | 208 | 209 | | | | | 210 | | 215 | 217 | 218 | | 220 | 222 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28/8 | | | 29/8 | 29/8 | | | | | 30/8 | | 31/8 | 1/9 | 2/9 | | 4/9 | 4/9 | |
| 39°32′ N.<br>5°15′ E. | | | 40°18′ N.<br>3°20′ E. | 40°34′ N.<br>3°03′ E. | | | | | 41°10′ N.<br>2°23′ E. | | 39°14′ N.<br>0°52′ E. | 38°01′ N.<br>1°48′ E. | 36°54′ N.<br>2°57′ E. | | 36°25′ N.<br>0°42′ E. | 35°53′ N.<br>0°57′ W. | |
| ca. 2860 | | | > 1600 | > 2000 | | | | | 780 | | > 1050 | > 2000 | ca. 2000 | | > 350 | ca. 2000 | |
| Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | D. 1 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 | Y. 200 |
| 300 | 1000 | 2000 | 25 | 25 | 300 | 1000 | 2000 | 2800 | 25 | 600 | 25 | 300 | 25 | 300 | 25 | 25 | 300 |
| 1/4 | 3/4 | 3/4 | 1/4 | 1/4 | 1/4 | 3/4 | 3/4 | 3 | 1/2 | 1/2 | 1/2 | 1/4 | 1/2 | 1/2 | 1/2 | 1/4 | 1/2 |
| $1^{05}$ | $1^{40}$ | $3^{05}$ | $1^{40}$ | $4^{55}$ | $5^{25}$ | $6^{00}$ | $7^{25}$ | $9^{30}$ | $2^{45}$ | $3^{35}$ | $21^{20}$ | $13^{40}$ | $2^{00}$ | $2^{45}$ | $2^{15}$ | $22^{50}$ | $23^{20}$ |
| 49 | 27 | 15 | 8 | .. | 1 | 28 | 8 | .. | .. | 5 | .. | .. | .. | 4 | 1 | .. | .. |
| 1 | 1 | .. | .. | .. | .. | 14 | 3 | .. | .. | 1 | .. | .. | .. | 1 | 1 | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 92 | 59 | 66 | 161 | .. | .. | 179 | 48 | 1 | 183 | 83 | 167 | .. | 6500 | 190 | 486 | 47 | 109 |
| 12 | 10 | 12 | .. | .. | .. | 16 | 1 | .. | 27 | 9 | .. | .. | .. | .. | .. | .. | .. |
| 389 | 81 | 62 | .. | .. | .. | 16 | 17 | .. | 6 | 8 | .. | .. | .. | 2 | 44 | .. | .. |
| 2 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 21 | .. | .. | 5 |
| 41 | 310 | 200 | .. | 4 | 14 | 540 | 133 | 3 | .. | 334 | .. | 11 | .. | 130 | 8 | .. | 300 |
| 6 | 38 | 34 | .. | .. | .. | 24 | 5 | .. | .. | 10 | .. | 2 | .. | 15 | 2 | .. | 1 |
| 88 | 49 | 51 | .. | .. | 63 | 112 | 12 | .. | .. | 34 | .. | 133 | .. | 45 | .. | .. | 377 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | 4 | 7 | .. | .. | 10 | 6 | 1 | .. | .. | 9 | .. | 6 | .. | .. | .. | .. | 1 |
| 19 | 17 | 7 | .. | .. | .. | .. | .. | .. | .. | 13 | .. | 10 | .. | 6 | .. | .. | 6 |

ontinued)

Mediterranean 1911—1912

| | 283 | | 275 | 276 | 277 | 296 | 297 | 298 | 339 | | 340 | | 341 | | 412 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 12/8 11 | | 3/4 11 | 4/4 11 | 6/4 11 | 25/6 11 | 25/6 11 | 26/6 11 | 20/8 11 | | 26/8 11 | | 27/8 11 | | 7/1 12 |
| | 38°12′ N.<br>15°37′ E. | 38°12′ N.<br>15°37.5′E. | 39°05′ N.<br>14°50′ E. | 36°30′ N.<br>19°20′ E. | 33°20′ N.<br>27°30′ E. | 32°10′ N.<br>29°50′ E. | 33°10′ N.<br>25°03′ E. | 34°20′ N.<br>21°10′ E. | 40°30′ N.<br>3°10′ E. | | 35°50′ N.<br>21°30′ E. | | 34°00′ N.<br>26°20′ E. | | 34°33′ N.<br>24°15′ E. |
| | (200) | (200) | > 1000 | > 3000 | > 3000 | > 2000 | > 2000 | > 2000 | > 2000 | | > 2000 | | > 2000 | | > 2000 |
| S. 100 | S. 100 | S. 100 | S. 200 | S. 200 | S. 200 | S. 200 | S. 200 | S. 200 | S. 200 | S. 150 | S. 200 | S. 150 | S. 200 | S. 150 | S. 150 |
| 40 | 40 | 40 | 94 | 132 | 132 | 28 | 28 | 38 | 28 | 90 | 28 | 108 | 28 | 108 | 112 |
| 1 1/2 | 3 | 3 | 1/2 | 35/60 | 35/60 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 |
| $21^{00}$ | $18^{30}$ | $21^{45}$ | $20^{30}$ | $23^{20}$ | $23^{00}$ | $2^{00}$ | $23^{30}$ | $23^{30}$ | $3^{00}$ | $3^{00}$ | $21^{00}$ | $21^{00}$ | $23^{00}$ | $23^{00}$ | $18^{30}$ |
| .. | .. | juv. | 320 | 634 | 399 | .. | juv. | 2 | c. | .. | 2 | 40 | 6 | .. | 1 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 5 | juv. | .. | 1 | 3 | .. | .. | .. | .. | .. | 20 | 1 | .. | .. | 2 | 4 |
| 2 | juv. | .. | 67 | 172 | 46 | 224 | ad. | 346 | c. | 61 | 50 | 39 | 147 | 2 | c. |
| 5 | juv. | juv. | 112 | 162 | 15 | 22 | juv. | 6 | c. | .. | 3 | 21 | 4 | .. | 50 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 17 | juv. | juv. | 5 | 1 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 11 | .. | juv. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | juv. | ad. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | .. | ad. | .. | .. | .. | .. | juv. | .. | .. | .. | .. | .. | .. | .. | c. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| .. | juv. | juv. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 1 |

**Table II. Length-measurements of *Meganyctiphanes***

| Length in mm | | Mediterranean | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Winter 1908—1909 | | | | | | | | | | | | | | | Summe | | | | | |
| | St... | 13 | 14 | 15 | 24 | 26 | 27 | 28 | 29 | 30 | 31 | 34 | 35 | 36 | 38 | 57 | 106 | 115 | 116 | 118 | 120 | 122 |
| | Date | 19/12 | 21/12 | 22/12 | 16/1 | 19/1 | 20/1 | 19/1 | 20/1 | 21/1 | 22/1 | 23/1 | 28/1 | 30/1 | 31/1 | 20/2 | 25/6 | 28/6 | 30/6 | 30/6 | 1/7 | 2/7 |
| 30 | | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 29 | | 1 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 28 | | 16 | .. | .. | .. | 2 | .. | 2 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 27 | | 89 | 4 | .. | .. | 13 | 7 | 20 | 2 | .. | 2 | .. | .. | 3 | 1 | .. | .. | .. | .. | .. | .. | .. |
| 26 | | 121 | 23 | 4 | 1 | 23 | 21 | 48 | 1 | 3 | 8 | 1 | 6 | 19 | 3 | .. | .. | .. | .. | 1 | .. | .. |
| 25 | | 91 | 49 | 18 | .. | 39 | 25 | 102 | 8 | 7 | 25 | 16 | 31 | 46 | 3 | .. | .. | .. | 1 | 1 | 3 | .. |
| 24 | | 59 | 57 | 16 | 3 | 21 | 25 | 96 | 2 | 10 | 28 | 20 | 36 | 50 | 2 | .. | .. | .. | 4 | .. | 6 | .. |
| 23 | | 32 | 64 | 22 | 1 | 3 | 11 | 42 | 1 | 14 | 31 | 20 | 16 | 19 | 6 | .. | .. | .. | 4 | 1 | 9 | 1 |
| 22 | | 9 | 47 | 16 | 3 | 1 | 2 | 5 | .. | 5 | 10 | 12 | 20 | 48 | 1 | .. | .. | .. | 5 | 1 | 1 | .. |
| 21 | | 3 | 12 | 7 | .. | .. | .. | 3 | .. | 1 | 3 | 17 | 26 | 56 | 1 | .. | .. | .. | 2 | .. | 1 | .. |
| 20 | | .. | 4 | 5 | .. | .. | .. | 1 | .. | .. | .. | 49 | 42 | 44 | .. | .. | .. | .. | 1 | .. | .. | .. |
| 19 | | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 28 | 11 | 9 | .. | .. | .. | .. | 3 | 2 | .. | .. |
| 18 | | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 8 | 2 | 1 | .. | .. | 1 | .. | .. | .. | .. | .. |
| 17 | | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 1 | .. | .. | 1 | 1 |
| 16 | | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 2 | 3 | .. | 5 | 1 |
| 15 | | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 9 | 10 | 6 | 2 | 9 |
| 14 | | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 26 | 21 | 20 | 2 | 8 |
| 13 | | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 2 | 25 | 61 | 50 | 1 | 13 |
| 12 | | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 19 | 84 | 122 | 3 | 13 |
| 11 | | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 3 | 15 | 109 | 151 | 1 | 8 |
| 10 | | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 1 | 9 | 124 | 188 | 2 | 11 |
| 9 | | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 1 | .. | 1 | 109 | 151 | 1 | 13 |
| 8 | | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 1 | .. | 1 | 87 | 131 | 6 | 3 |
| 7 | | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 37 | 52 | 1 | .. |
| 6 | | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 2 | 6 | .. | .. |
| $N_1$ | | 421 | 260 | 88 | 8 | 102 | 91 | 319 | 14 | 30 | 107 | 69 | 89 | 137 | 17 | .. | .. | .. | 20 | 9 | 20 | 1 |
| $M_1$ | | 25.45 | 23.60 | 23.22 | 23.38 | 25.25 | 24.80 | 24.63 | 25.07 | 23.53 | 23.88 | 23.62 | 24.30 | 24.54 | 24.06 | .. | .. | .. | 22.10 | 22.66 | 23.45 | 23.0 |
| $N_2$ | | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 102 | 101 | 158 | .. | 2 | 7 | 118 | 647 | 881 | 28 | 80 |
| $M_2$ | | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 19.74 | 20.50 | 20.89 | .. | 8.5 | 12.43 | 12.70 | 10.23 | 10.69 | 11.86 | 11.80 |

$N_1$ is the number and $M_1$ the mean length of the mature individuals, $N_2$ and $M_2$ the number and mean length of the immature individuals. See also page 23.

## *orvegica* **M. Sars.** (Measurements by Vilh. Ege).

| | | | | | | | | | Atlantic | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | | | | | | | | | Winter 1908–1909 | | | | | | | | Summer 1910 | | | | | | |
| 25 | 126 | 131 | 132 | 138 | 197 | 199 | 204 | 209 | 8 | 65 | 66 | 68 | 69 | 71 | 74 | 75 | 80 | 81 | 85 | 89 | 231 | 244 | 245 |
| /7 | 10/7 | 13/7 | 11/7 | 19/7 | 24/8 | 26/8 | 27/8 | 29/8 | 4/12 | 24/2 | 25/2 | 27/2 | 28/2 | 4/3 | 8/3 | 9/3 | 10/8 | 15/8 | 17/8 | 18/8 | 9/9 | 17/9 | 17/9 |
| . | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 1 | .. | .. | .. | .. | .. | .. | .. |
| . | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 3 | 1 | .. | .. | .. | .. | .. | .. | .. | .. |
| . | .. | .. | .. | .. | .. | .. | .. | .. | .. | 1 | 1 | .. | .. | 16 | .. | 1 | .. | 2 | .. | .. | .. | .. | .. |
| 2 | .. | .. | .. | .. | .. | .. | .. | .. | .. | 1 | 13 | .. | 2 | 26 | 3 | 1 | 6 | 11 | 1 | .. | .. | .. | 1 |
| 5 | .. | .. | .. | .. | .. | .. | .. | .. | .. | 5 | 34 | .. | 12 | 37 | 5 | 4 | 14 | 28 | 3 | .. | .. | 2 | 11 |
| 26 | 1 | .. | .. | .. | 1 | .. | .. | .. | .. | 19 | 114 | 10 | 27 | 38 | 9 | 3 | 11 | 41 | 10 | .. | .. | 15 | 13 |
| 12 | 3 | .. | .. | .. | 1 | .. | .. | .. | .. | 13 | 262 | 29 | 55 | 45 | 6 | 8 | 4 | 21 | 5 | .. | .. | 24 | 4 |
| 10 | 7 | .. | .. | .. | 1 | .. | .. | .. | 1 | 19 | 329 | 62 | 78 | 58 | 25 | 27 | 5 | 9 | 2 | .. | .. | 4 | 3 |
| 10 | 3 | .. | .. | .. | 1 | .. | .. | .. | 3 | 8 | 172 | 99 | 74 | 51 | 86 | 107 | .. | 2 | 2 | .. | 8 | 1 | 1 |
| 5 | 3 | .. | .. | 5 | 1 | .. | .. | .. | 4 | 1 | 76 | 74 | 25 | 21 | 174 | 148 | | 4 | 5 | .. | 13 | 1 | 1 |
| 3 | 17 | .. | .. | 5 | 2 | 1 | .. | .. | 10 | .. | 26 | 24 | 3 | 2 | 224 | 134 | 1 | 16 | 24 | .. | 18 | 2 | 5 |
| 2 | 12 | 1 | 2 | 9 | 2 | 4 | 4 | .. | 5 | .. | 1 | 1 | .. | 1 | 101 | 61 | 1 | 24 | 49 | 3 | 16 | 1 | 5 |
| 3 | 11 | .. | 4 | 4 | .. | 11 | 5 | .. | .. | .. | .. | .. | .. | .. | 30 | 15 | 10 | 33 | 57 | 8 | 23 | 1 | 4 |
| 12 | 12 | 1 | 15 | 10 | 1 | 5 | 5 | 3 | .. | .. | .. | .. | .. | .. | 8 | 1 | 33 | 24 | 48 | 11 | 9 | .. | 4 |
| 5 | 6 | .. | 14 | 18 | .. | .. | 10 | 3 | .. | .. | .. | .. | .. | .. | 2 | 1 | 51 | 22 | 23 | 8 | 1 | 2 | .. |
| 10 | 4 | .. | 5 | 17 | .. | .. | 6 | 5 | .. | .. | .. | .. | .. | .. | .. | .. | 90 | 17 | 16 | 7 | .. | 1 | .. |
| 9 | 5 | 3 | .. | 22 | .. | .. | 2 | .. | .. | .. | .. | .. | .. | .. | .. | .. | 89 | 15 | 4 | 5 | .. | 1 | .. |
| 21 | .. | 5 | .. | 52 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 58 | 13 | 2 | 1 | .. | 1 | .. |
| 32 | .. | 3 | .. | 29 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 109 | 16 | 1 | 3 | .. | 1 | .. |
| 56 | .. | 3 | .. | 15 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 103 | 8 | .. | 3 | .. | .. | .. |
| 18 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 55 | 6 | .. | .. | .. | .. | .. |
| 22 | . | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 14 | 1 | .. | .. | .. | .. | .. |
| 7 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 1 | .. | .. | .. | .. | .. | 21 | .. | .. | .. | .. | .. | .. |
| 1 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 3 | .. | .. | .. | .. | .. | 4 | .. | .. | .. | .. | .. | .. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 35 | 4 | .. | .. | .. | .. | .. | .. | .. | .. | 67 | 1030 | 299 | 276 | 298 | .. | .. | 40 | 114 | 21 | .. | .. | 46 | 33 |
| 3.59 | 21.25 | .. | .. | .. | .. | .. | .. | .. | .. | 23.97 | 23.24 | 22.83 | 23.04 | 24.11 | .. | .. | 25.30 | 25.10 | 24.81 | .. | .. | 24.28 | 25.00 |
| 26 | 73 | 16 | 40 | 186 | 10 | 21 | 32 | 11 | 23 | .. | 4 | .. | .. | .. | 674 | 509 | 669 | 199 | 231 | 49 | 88 | 11 | 19 |
| 1.62 | 18.15 | 13.25 | 16.60 | 14.30 | 21 | 18.05 | 16.53 | 15.82 | 20.35 | .. | 7.25 | .. | .. | .. | 20.53 | 20.86 | 12.75 | 16.07 | 17.86 | 15.78 | 19.27 | 16.72 | 18.74 |

## Table III. Relative number percent per haul in the different areas.

| Species | Atlantic & Biscay | Cadiz Bay | Alboran Sea | Balearic Sea | Catalonian Sea | Ligurian Sea | Tyrrhenian Sea | Ionian Sea | Adriatic Sea | Sidra Sea | Levant | Aegean Sea | Marmara Sea |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1908–1909 | | | | | | | | | | | | | |
| *Thysanopoda aequalis* | 0.1 | 1.3 | 3.1 | 22.9 | .. | 3 | 40.4 | 21.5 | 9.0 | .. | .. | 0 | .. |
| *Euphausia brevis* | 0 | 3.4 | 0 | 16.4 | .. | 1.1 | 22.6 | 50.1 | 5.1 | .. | .. | 1.1 | .. |
| *Euphausia hemigibba* | 0 | 2.3 | 1.5 | 16.5 | .. | 1.5 | 18.8 | 51.7 | 6.9 | .. | .. | 0 | .. |
| *Euphausia krohnii* | 2.6 | 1.2 | 36.2 | 24.6 | .. | 0.8 | 10.3 | 2.0 | 19.0 | .. | .. | 3.4 | .. |
| *Meganyctiphanes norvegica* | 13.8 | 32.3 | 0.2 | 0.1 | .. | 7.3 | 2.0 | 38.7[1]) | 5.7 | .. | .. | 0.1 | .. |
| *Nyctiphanes couchii* | 8.3 | 86.7 | 1.7 | 0.3 | .. | 0 | 0.3 | 0.2 | 0.7 | .. | .. | 2.0 | .. |
| *Nematoscelis megalops* | 1.3 | 0.4 | 32.8 | 18.4 | .. | 7.4 | 2.5 | 3.4 | 29.8 | .. | .. | 4.0 | .. |
| *Nematoscelis atlantica* | 0 | 11.6 | 3.3 | 26.7 | .. | 0.5 | 6.7 | 36.7 | 13.3 | .. | .. | 1.7 | .. |
| *Stylocheiron longicorne* | 0.3 | 3.3 | 33.4 | 20.3 | .. | 6.6 | 8.5 | 7.2 | 15.7 | .. | .. | 4.5 | .. |
| *Stylocheiron suhmii* | 0 | 9.0 | 0.9 | 0 | .. | 0 | 3.0 | 81.0 | 6.0 | .. | .. | 0 | .. |
| *Stylocheiron abbreviatum* | 0.4 | 5.7 | 8.6 | 57.1 | .. | 0.7 | 10.0 | 7.1 | 4.3 | .. | .. | 5.7 | .. |
| 1910 | | | | | | | | | | | | | |
| *Thysanopoda aequalis* | 0.2 | 6.3 | 0 | 15.3 | 1.5 | 1.3 | 28.7 | 25.4 | .. | 7.0 | 12.4 | 2.0 | 0 |
| *Euphausia brevis* | 0 | 16.7 | 0 | 8.3 | 2.7 | 3.8 | 21.8 | 9.2 | .. | 16.7 | 20.4 | 0.7 | 0 |
| *Euphausia hemigibba* | 0 | 14.0 | 0.3 | 18.9 | 0.9 | 2.4 | 25.7 | 19.3 | .. | 10.2 | 7.3 | 1.0 | 0 |
| *Euphausia krohnii* | 2.1 | 3.9 | 19.7 | 28.8 | 6.0 | 6.7 | 9.7 | 3.0 | .. | 0.05 | 0.45 | 14.0 | 4.6 |
| *Meganyctiphanes norvegica* | 77.0 | 10.2 | 0.04 | 1.4 | 0.08 | 10.7 | 0.4 | 0.04 | .. | 0 | 0.01 | 0 | 1.6 |
| *Nyctiphanes couchii* | 99.0 | 0.3 | 0 | 0.62 | 0 | 0 | 0 | 0 | .. | 0 | 0 | 0.08 | 0 |
| *Nematoscelis megalops* | 2.8 | 1.1 | 29.9 | 20.4 | 11.9 | 12.7 | 13.4 | 3.1 | .. | 0.1 | 0 | 3.9 | 0.6 |
| *Nematoscelis atlantica* | 0 | 37.5 | 4.1 | 23.7 | 6.0 | 4.1 | 13.1 | 4.8 | .. | 3.0 | 3.6 | 1.2 | 0 |
| *Stylocheiron longicorne* | 4.2 | 4.2 | 11.0 | 13.2 | 18.3 | 4.0 | 10.3 | 7.9 | .. | 4.6 | 4.4 | 17.6 | 0 |
| *Stylocheiron suhmii* | 0 | 1.5 | 0 | 1.5 | 0 | 0 | 1.5 | 22.1 | .. | 8.4 | 12.2 | 52.8 | 0 |
| *Stylocheiron abbreviatum* | 2.1 | 5.6 | 1.1 | 6.7 | 3.5 | 1.9 | 17.4 | 11.5 | .. | 22.0 | 14.2 | 13.9 | 0 |

[1]) Bay of Tarent.

REPORT ON THE DANISH OCEANOGRAPHICAL EXPEDITIONS 1908–10
TO THE MEDITERRANEAN AND ADJACENT SEAS

**Vol. II. Biology.**

---

E. 1.

# Pelagic Polychaetes

of the families

## *Aphroditidae*, *Phyllodocidae*, *Typhloscolecidae* and *Alciopidae*.

By

Elise Wesenberg-Lund.

With 30 figures and 23 charts in the text.

Published March 31, 1939.

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# INTRODUCTION

The present paper deals with the pelagic Polychaetes except the Tomopterids collected on the cruises of the "Thor", 1905—06 in the Atlantic South of Ireland and 1908—10 in the Mediterranean and adjacent waters; further, the collections made by Capt. G. Hansen of the "Thor" in the Straits of Messina 1911 and by S/S "Pangan" in the middle and eastern basin of the Mediterranean 1911; finally, it includes the materials originating from the collections of the "Dana" 1921 and 1930 in the Mediterranean and the Gulf of Cadiz etc.

The majority of the catches were made with "Petersen's Young-fish Trawl" mostly with a diameter of 200 cm. and 330 cm. (Y 200 and Y 330) and stramin nets with diameters of 100, 150 and 200 cm. (S 100, S 150, S 200); the fishing parts of these consist of stramin, a coarse canvas with abt. 20 threads to 3 cm. A few samples containing Polychaeta were taken with other apparatus, viz. 5 samples with ring-trawl 130 cm., 200 cm. and 300 cm. in diameter (C 130, C 200, E 300 resp.); 2 samples with open conical silk-net 100 cm. in diameter (P 100); one with Nansen's closing net, 50 cm. in diameter (N 50) and finally one with rectangular dredge opening, 27 × 117 cm. ($D_1$).

In the "Introductions" to the "Thor" reports (1912) and the "Dana" reports (1934) a description is given of the apparatus employed as well as a complete list of all stations.

The most effective instruments for taking Polychaetes proved to be the young-fish trawl 200 and the stramin net 200.

In the analysis of the samples the different species were first sorted out into dishes and subsequently counted as far as was possible. As regards the Alciopids this was very difficult, since the specimens during preservation had often broken into numerous pieces and it proved impossible to reestablish the individuals. In these cases only the fragments with the heads were counted and I am fully aware that there may be room for mistakes here. It is my intention in a later paper, dealing with the Tomopterids from the same collections in a similar way, to give some general conclusions as to the frequency and distribution of the species, vertical as well as horizontal, in the different parts of the areas here considered etc. The present paper therefore is mainly of a systematic-morphological character.

There is no doubt that treatment of all the collections of pelagic Polychaetes from the Mediterranean and adjacent parts of the Atlantic will add considerably to our knowledge of the biology of this group, mainly because previous collections have been carried out in shallow waters close to the shores; for the first time we here have collections from almost all parts of these areas and especially from the open sea. We may even say, that the "Thor" and "Dana" collections may offer the first basis for a biological study of the pelagic Polychaetes from any sea-area of comparable extent—just as the "Thor" and "Dana" collections of Siphonophores, Medusae, different Crustaceans, Decapods, Fishes etc. have done.

Nevertheless, a preliminary study of the biology of the pelagic Polychaetes, exclusive of the Tomopterids, shows that these forms are not by far of the same quantitative value in the plankton as some of the groups mentioned above. The lists will show that the number of individuals per catch is almost always very small.

I beg Dr. Å. V. Tåning to accept my sincerest thanks for handing over to me this fine material and for procuring financial support, which enabled me to engage assistance of various kinds. The drawings were made by the scientific artist Poul H. Winther, whom I wish to thank for his beautiful work and good collaboration. I also wish to thank Mrs. V. Holm for her valuable assistance.

November 1938. *The Zoological Museum of the University of Copenhagen.*

## Family APHRODITIDAE

### Subfamily POLYNOINAE Grube.

The Polynoids are not altogether true pelagic annelids. Only the larvæ are normally found in the plankton. As adults they generally occur at considerable depths; their descending through the water therefore often takes place very slowly. During the descending they assume the post-larval characters which make them fit for a bathypelagic life of short duration and during this period they may now and then be taken in the different dredging apparatus. When they reach the bottom, they gradually lose their larval characters and change slowly into adults. This is true especially of the following Polynoids: *Lagisca Hubrechti*, *Harmothoë longisetis* and *Nectochaeta Grimaldi* and perhaps of the others too (Fauvel 1916, p. 49).

The material contains five Polynoids all taken pelagically: *Harmothoë longisetis, Lagisca Hubrechti, L. extenuata, Nectochaeta Caroli* and *N. Grimaldi.* They were all previously known as bathypelagic species with the exception of *L. extenuata,* which was taken in shallow water and only by chance came into the young-fish trawl. It would have been reasonable to expect still another Polynoid in the large material here investigated viz. *Harmothoë Johnstoni* (McInt.). It is known i. a. from the Bay of Biscay and Gibraltar; furthermore, it is a true pelagic form, like *L. Hubrechti* in possession of a caudal appendix which may be considered serviceable to a free swimming organism.

### HARMOTHOË LONGISETIS (Grube).

*Harmothoë longisetis* Fauvel 1914, p. 58.
*Harmothoë longisetis* Fauvel 1916, p. 21.
*Harmothoë longisetis* Fauvel 1923 p. 66.
*Harmothoë longisetis* Fauvel 1934, p. 12.

Material.

| Station Nr. "Dana" | Lat. | Long. | Depth Metres | Date | Hour | Gear | Wire out Metres | Duration of haul in minutes | Number of specimens |
|---|---|---|---|---|---|---|---|---|---|
| 4136 | 36°06′ N. | 0°16′ W. | 2500 | 7-6-30 | $1^{45}$ | S. 150 | 950 | 90 | 1 |

The single specimen measures 18 mm. by 3 mm. exclusive and 9 mm. inclusive of the feet and the long setæ. The colour is yellow, bristles gold glimmering, the scales yellowish white, very thin and delicate, almost transparent. The prostomium is rounded without frontal horns. The antennæ and tentacular cirri as vell as the dorsal and ventral cirri are furnished with small oblong papillæ. The

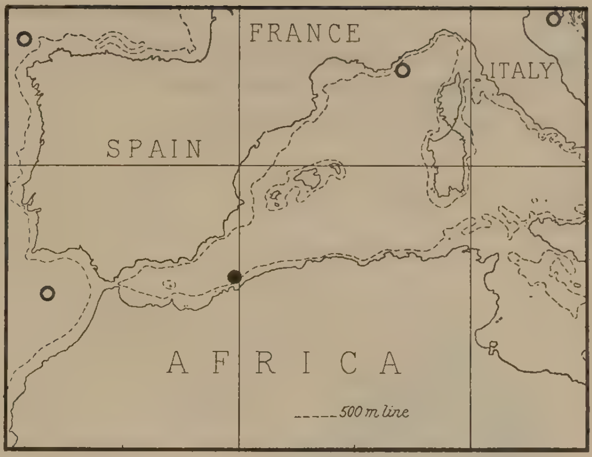

Chart 1. Occurrence of *Harmothoë longisetis* (Grube).
● new record. ○ previous records.

palps are glabrous. The scales are covered with numerous small chitinous papillæ only revealed by high magnifying power. At the posterior border of the scales we find a few, scattered club-shaped or capitated cirriform papillæ, but no fringe. The foot is biramous, the notopodium short with short and coarse, nearly straight bristles with numerous rows of small spines. The neuropodium is prolongated into a long filiform appendage. The longest of the neuropodial bristles are almost twice as long as the dorsal ones; they are very fine, their spinous portion very long; the point is bifurcated (bidentate), the secondary tooth very delicate and directed upwards. In the dorsal and ventral margin of the neuropodial bundle of setæ some few bristles are found without the secondary tooth (unidentate); the most ventral of them are furthermore differently shaped as they are flattened just inside the hirsute tip. The last segment carries two long white pygidial styles.

The species is generally not considered pelagic, it may however occur amongst the benthonic fauna at any rate in the juvenile stage. As adult it is found on the bottom. The present find which originates from the Alboran Sea has been taken in the open stramin net about 30 m. from the surface. Fauvel too reports it amongst the pelagic Polychaetes.

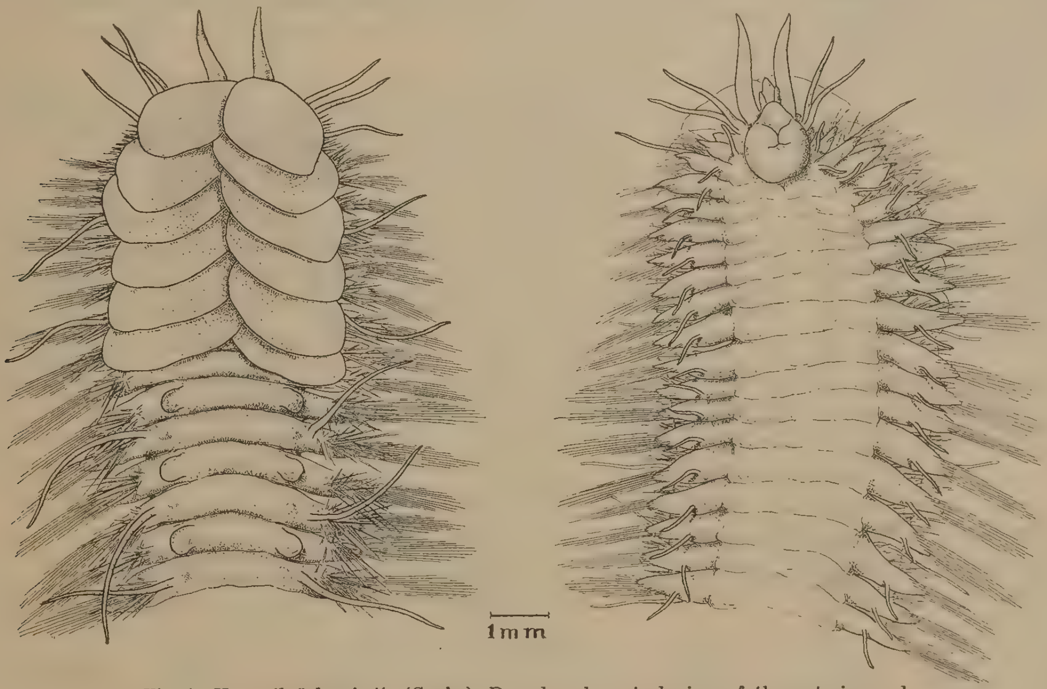

Fig. 1. *Harmothoë longisetis* (Grube). Dorsal and ventral view of the anterior end.

The species was previously known from the Mediterranean. Fauvel mentions it from the Balearic Islands, from off Monaco and from Rovigno, furthermore from the Gulf of Cadiz and the Bay of Biscay. Further distribution: The arctic area of the Atlantic region and the Channel.

## LAGISCA EXTENUATA (*Grube*).

*Lagisca elizabethae* Southern 1914, p. 51.
*Lagisca extenuata* Fauvel 1914, p. 62.
*Lagisca extenuata* Fauvel 1916, p. 32.
*Lagisca extenuata* Fauvel 1923, p. 76.
*Lagisca extenuata* Fauvel 1934, p. 14.

Material.

| Station Nr. "Thor" | Lat. | Long. | Depth Metres | Date | Hour | Gear | Wire out Metres | Duration of haul in minutes | Number of specimens |
|---|---|---|---|---|---|---|---|---|---|
| 249 | 51°08' N. | 1°15' E. | ~ 50 | 21.9.10 | $23^{00}$ | Y. 200 | 65 | 15 | 6 |

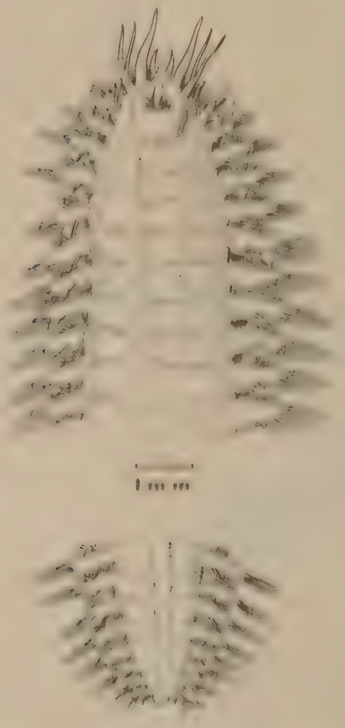

Fig. 2. *Lagisca extenuata* (Grube). Ventral view.

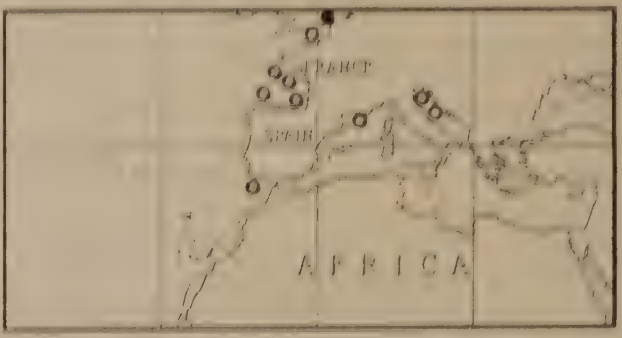

Chart 2. Occurrence of *Lagisca extenuata* (Grube).
● new record. ○ previous records.

Only six specimens from one single haul are to hand. The longest one measures 26 mm. by 7 mm. 15 pairs of elytra easily distinguished by 6–8 big ovoid papillae at the posterior border. The antennae and cirri are covered with small papillae. No caudal appendage. – The single record is from the Channel in the Strait between Dover and Calais, coinciding with the fact that the species is the most common Polynoid in the Channel. It has also a very wide distribution in the adjacent waters, as it is found in Irish seas (Southern 1914), on the Dogger Bank and in abundance in the Bay of Biscay (Fauvel 1914). It is furthermore reported from east of the Orkney Islands and the Arctic. From the Mediterranean it was previously reported by Fauvel (1914) from off Monaco and from the Adriatic Sea (1934).

*Lagisca extenuata* is not a true pelagic species; it generally occurs between and under stones and shells especially in shallow waters. It has probably come into the young-fish trawl by mere chance.

## LAGISCA HUBRECHTI (McIntosh).

*Evarne Hubrechti* McIntosh 1900, p. 360.
*Lagisca Hubrechti* Fauvel 1914, p. 67.
*Lagisca Hubrechti* Fauvel 1916, p. 28.
*Lagisca Hubrechti* Fauvel 1923, p. 78.
*Lagisca Hubrechti* Monro 1930, p. 45.
*Lagisca Hubrechti* Fauvel 1932, p. 10.

Material.

| Station Nr. "Thor" | Lat. | Long. | Depth Metres | Date | Hour | Gear | Wire out Metres | Duration of haul in minutes | Number of specimens |
|---|---|---|---|---|---|---|---|---|---|
| 36 | 44°21' N. | 2°37' W. | 1050–1035 | 10.5.06 | $9^{00}$ | Y. 330 | 800 | 120 | 4 |
| 61 | 51°04' N. | 11°59' W. | 1450 | 31.5.06 | $18^{00}$ | Y. 330 | 800 | 120 | 5 |
| 62 | 50°25' N. | 12°44' W. | 2775 | 5.6.06 | $2^{40}$ | Y. 330 | 1500 | 120 | 6 |
| 74 | 49°23' N. | 12°15' W. | 1245–1298 | 10.6.06 | $6^{00}$ | Y. 330 | 2000 | 60 | 6 |
| 76 | 49°27' N. | 13°33' W. | ~ 2600 | 11.6.06 | $15^{00}$ | Y. 200 | 2800 | 120 | 2 |
| 178 | 48°04' N. | 12°40' W. | 4000 | 2.9.06 | $9^{00}$ | Y. 330 | 1800 | 120 | 40 |
| 179 | 47°20' N. | 12°23' W. | ~ 4000 | 3.9.06 | $0^{00}$ | Y. 330 | 600 | 120 | 21 |
| 180 | [illegible] | 13°53' W. | ~ 4000 | 3.9.06 | $17^{00}$ | Y. 330 | 1800 | 60 | 5 |
| 240 | 44°34' N. | 8°16' W. | ~ 4000 | 15.9.10 | $21^{40}$ | Y. 200 | 1000 | 30 | 1 |

A fairly great number of specimens available; all originate from the waters S. W. of Ireland and from the Bay of Biscay, where the species previously was well known. It is characterised by the row of scales which just as in the preceding species does not cover the last segments; but in contradistinction to the same species the elythra do not possess the conspicuous row of big papillæ at the posterior border.

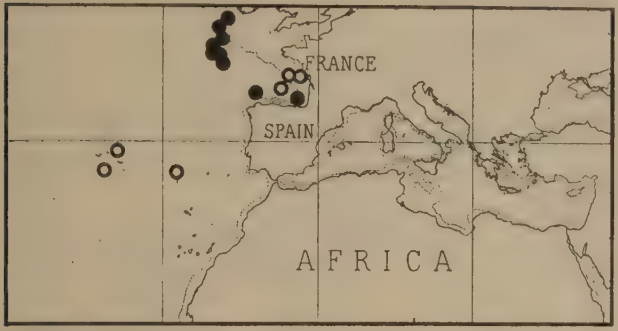

Chart 3. Occurrence of *Lagisca Hubrechti* (McIntosh).
● new records. ○ previous records.

The antennæ and cirri are glabrous. A large white caudal appendage is present. The specimens to hand are all rather small, varying from 7 to 21 mm. in length; they are much damaged, none of them being in possession of the normal number, 15 pairs, of elythra.

The species is, in contradistinction to its congener, a true bathypelagic form; undoubtedly the long rudder-like caudal appendage is used as a swimming organ; the body does not otherwise convey the impression of a pelagic species. As seen in the list of finding places above, by far the greater part of the hauls have been made with the young-fish trawl with a very long wire and all of them over great depths. It has only been taken in summer time often in fairly great number; it seems to be of some quantitative value in the bathy-necton in the waters west of England and France. The species is not known from the Mediterranean; the cause must probably be found in the supposition, that this deep-sea form is not able to cross the threshold at Gibraltar.

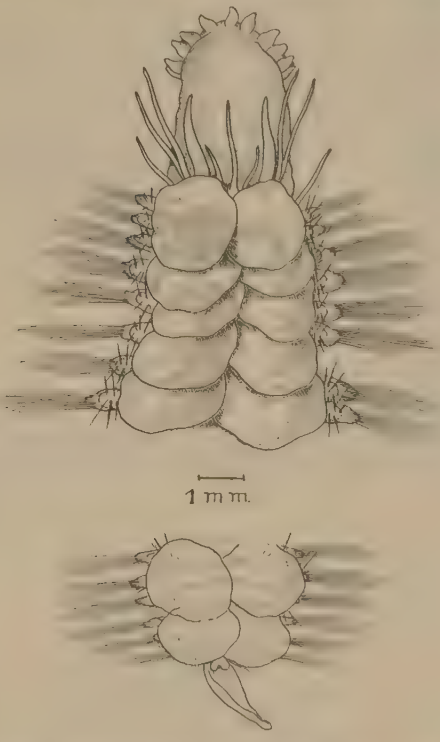

Fig. 3. *Lagisca Hubrechti* (McIntosh). Dorsal view.

*Lagisca Hubrechti* is widely distributed in the Atlantic; it is reported from New Foundland, South Africa and South Shetlands and from numerous localities in the interjacent area.

## NECTOCHAETA CAROLI Fauvel.

*Nectochaeta Caroli* Fauvel 1916, p. 148.
*Nectochaeta Caroli* Fauvel 1923, p. 91.
*Nectochaeta Caroli* Monro 1930, p. 46.

Material.

| Station Nr. | Lat. | Long. | Depth Metres | Date | Hour | Gear | Wire out Metres | Duration of haul in minutes | Number of specimens |
|---|---|---|---|---|---|---|---|---|---|
| "Thor" | | | | | | | | | |
| 190 | 46°30′ N. | 7°00′ W. | > 4000 | 11-9-06 | | | | | 1 |
| 112 | 36°56′ N. | 2°15′ E. | 2700 | 27-6-10 | $0^{15}$ | Y. 200 | 300 | 30 | 1 |
| 175 | 40°48′ N. | 27°59′ E. | 1103 | 11-8-10 | $23^{30}$ | N. 30 | 350 | 30 | 1 |
| 176 | 40°45′ N. | 27°43′ E. | > 500 | 12-8-10 | $4^{00}$ | Y. 200 | 65 | 30 | 10 |
| "Dana" | | | | | | | | | |
| 1133 | 36°10′ N. | 4°10′ W. | 1350 | 3-10-21 | $17^{10}$ | S. 200 | 1500 | 75 | 1 |
| 4004 | 10°21′ N. | 17°59′ W. | 2870 | 11-3-30 | $3^{15}$ | S. 200 | 300 | 120 | 6 |
| 4136 | 36°06′ N. | 0°16′ W. | 2500 | 7-6-30 | $1^{45}$ | S. 150 | 950 | 90 | 2 |
| 4139 | 36°21′ N. | 3°06′ W. | 850 | 8-6-30 | $1^{15}$ | S. 150 | 950 | 90 | 1 |

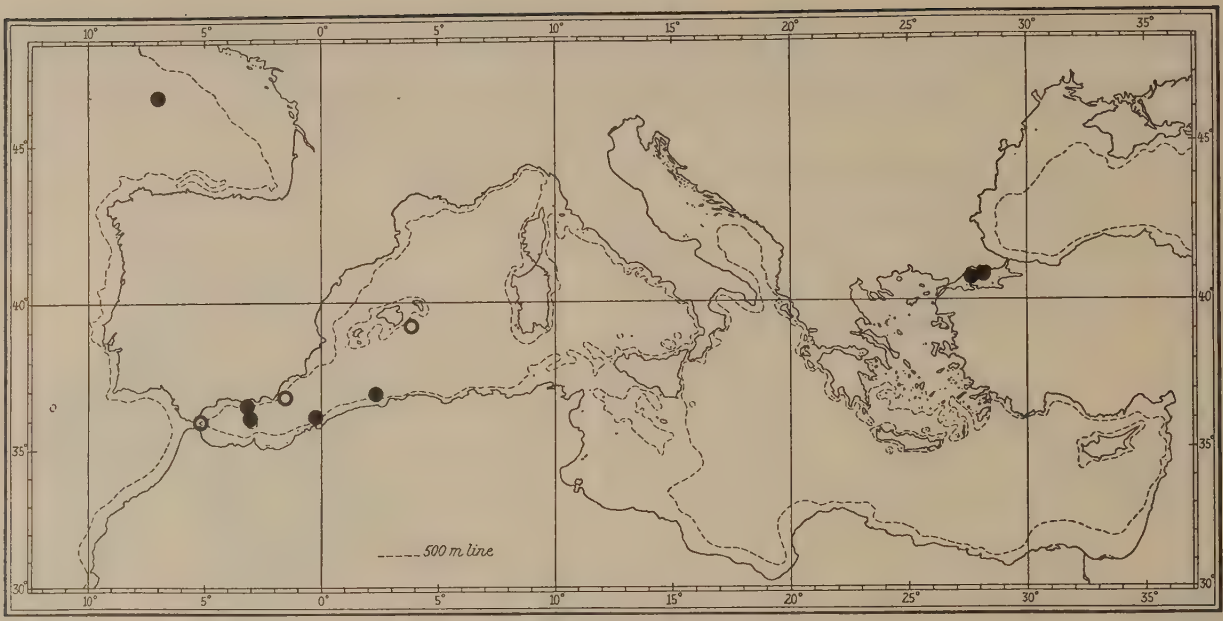

Chart 4. Occurrence of *Nectochaeta Caroli* Fauvel.
● new records. ○ previous records.

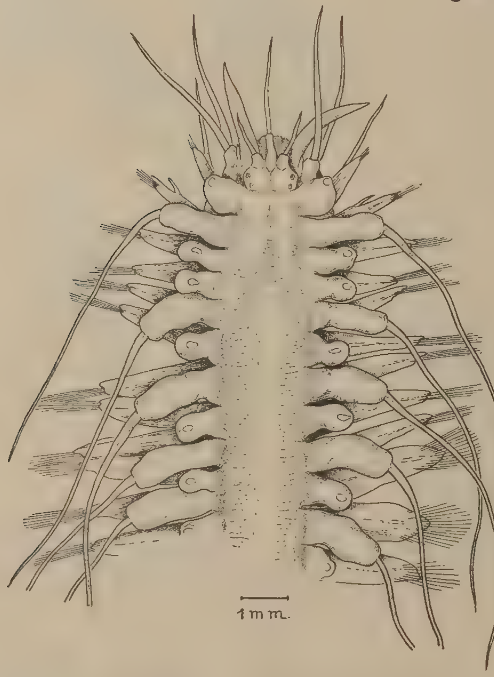

Fig. 4. *Nectochaeta Caroli* Fauvel. Dorsal view.

The length of the largest specimen is abt. 15 mm. The species is easily distinguished by its very long dorsal cirri on the top of enormous sausage-shaped cirrophores, almost of the same length as the feet and much longer than the elythrophores which are yet fairly long. Unfortunately none of the present animals is complete; they have all broken in two pieces and all the elythra are lost. In the much reduced dorsal ramus two sorts of bristles are present, the superior very long and hairlike with small spines, the inferior shorter and more coarse with two rows of fairly strong denticules; the tip however is threadlike without any tooth (unidental).

The species is oceanic, bathypelagic, with a wide distribution in the Lusitanian and tropic area of the Atlantic (Canary Islands, Azores, off Congo and Angola). In the present material the "Thor" occurrence in the Bay of Biscay is in the northern part of its area of distribution. It was previously reported from several localities in the western part of the Mediterranean; of special interest are the new records in the Sea of Marmora.

## **NECTOCHAETA GRIMALDI** Marenzeller.

*Nectochaeta Grimaldi* Marenzeller 1892, p. 173.
*Nectochaeta Grimaldi* Viguier 1911, p. 254.
*Nectochaeta Grimaldi* Fauvel 1914, p. 4.
*Nectochaeta Grimaldi* Fauvel 1916, p. 32.
*Nectochaeta Grimaldi* Fauvel 1923, p. 90.
*Nectochaeta Grimaldi* Fauvel 1932, p. 11.

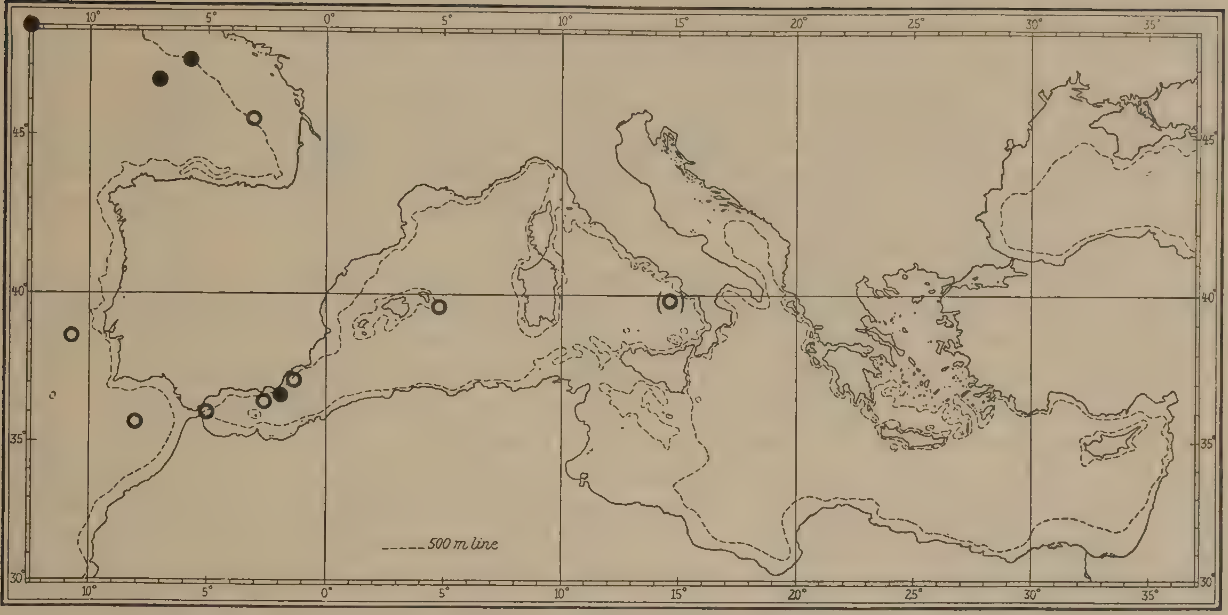

Chart 5. Occurrence of *Nectochaeta Grimaldi* Marenzeller.
● new records. ○ previous records.

Material.

| Station Nr. | Lat. | Long. | Depth Metres | Date | Hour | Gear | Wire out Metres | Duration of haul in minutes | Number of specimens |
|---|---|---|---|---|---|---|---|---|---|
| **"Thor"** | | | | | | | | | |
| 178 | 48°04′ N. | 12°40′ W. | 4000 | 2-9-06 | $9^{05}$ | Y. 330 | 1800 | 120 | 2 |
| 190 | 46°30′ N. | 7°00′ W. | > 4000 | 11-9-06 | $8^{25}$ | Y. 330 | 2700 | 150 | 1 |
| 76 | 47°01′ N. | 5°48′ W. | > 1200 | 10-3-09 | $14^{40}$ | Y. 200 | 1600 | 60 | 1 |
| 106 | 36°33′ N. | 2°00′ W. | ca. 1100 | 25-6-10 | $0^{20}$ | Y. 200 | 1200 | 60 | 1 |

The five specimens to hand are fairly small, the largest one abt. 15 mm. by 3 mm. inclusive of the feet. The species is distinguished from *N. Caroli* by the much shorter dorsal cirrophores, whereas the dorsal cirri have about the same length in the two species; the elytrophores are a little shorter and more slender than in *N. Caroli*. The dorsal ramus of the foot is reduced as in *N. Caroli*; besides the acicular bristles there are one or two very short denticulated bristles. The ventral ramus of the foot carries on the inferior border a row of small globular papillæ; there are two kinds of bristles; the superior being very long and hair-like with spines in the central portion, the inferior being shorter and more spatulate in the distal end which is strongly bidental.

The species was previously known from the Mediterranean. FAUVEL reports it from several localities in the western part; he furthermore (1916, p. 37) states, that the report of LO BIANCO (1904, p. 49) most likely refers to another Polynoid, probably either *Harmothoë benthophila* or *Lagisca Hubrechti* (Chart 5: (○)). As to the distribution the present material does not offer anything of interest.

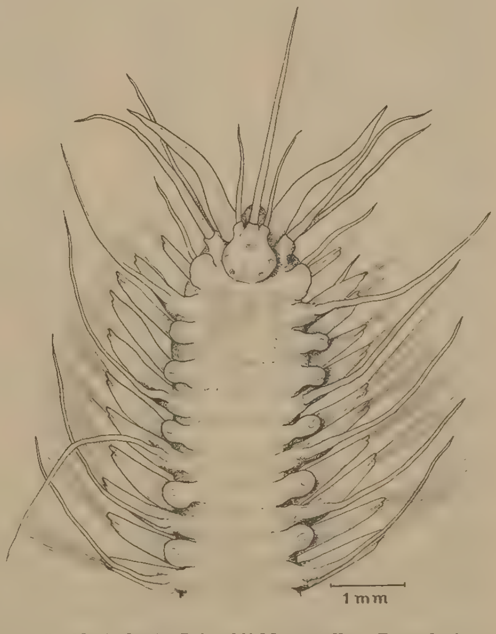

Fig. 5. *Nectochaeta Grimaldi* Marenzeller. Dorsal view.

# Family PHYLLODOCIDAE Grube.

The pelagic Phyllodocids are mainly included in the subfamilies *Lopadorhynchinae*, *Iospilinae*, *Pontodorinae* and *Lacydoniinae*. In the present material only the first subfamily is represented although the three others all have several representatives in the Mediterranean. Their absence may perhaps be explained by their diminutiveness; on an average they only measure a few mm., and furthermore they are not to be regarded as oceanic forms.

The *Lopadorhynchinae* contain four genera; *Lopadorhynchus* Grube, *Pedinosoma* Reibisch, *Maupasia* Viguier and *Pelagobia* Greeff all known from the Mediterranean. All the five species of *Lopadorhynchus* hitherto reported from the Mediterranean are represented in the "Thor" and "Dana" collections; *Pedinosoma* and *Pelagobia* are not found and of the genus *Maupasia* only *M. coeca* Viguier is present.

It holds good of all of them (perhaps with the exception of *Lopadorhynchus uncinatus* Fauvel and *L. brevis* Grube) that they are exceedingly small and rare forms, which can hardly play any rôle quantitatively in the plankton. All 5 species of *Lopadorhynchus* are oceanic forms which live in the upper waterlayers; since they are all known from wide-spread localities in the Atlantic, they must be supposed to have immigrated into the Mediterranean from the west. It may be noted, that just the species which is found mainly in the eastern part of the Mediterranean, *L. Krohnii* Reib., is the only one which is also known from the Indian Ocean. To draw any conclusion from this may however be premature.

## LOPADORHYNCHUS UNCINATUS Fauvel.

*Lopadorhynchus uncinatus* Fauvel 1915, p. 3.
*Lopadorhynchus uncinatus* Fauvel 1916, p. 57.
*Lopadorhynchus uncinatus* Fauvel 1923, p. 184.
*Lopadorhynchus uncinatus* Monro 1936, p. 113.

Material.

| Station Nr. | Lat. | Long. | Depth Metres | Date | Hour | Gear | Wire out Metres | Duration of haul in minutes | Number of specimens |
|---|---|---|---|---|---|---|---|---|---|
| "Thor" | | | | | | | | | |
| 93 | 49°25′ N. | 12°20′ W. | 1230—1350 | 24-6-05 | $19^{45}$ | Y. 330 | 300 | 120 | 1 |
| 37 | 44°01′ N. | 2°49′ W. | 1400 | 10-5-06 | $21^{55}$ | Y. 330 | 200 | 120 | 1 |
| 175 | 51°11′ N. | 11°41′ W. | 930—970 | 30-8-06 | $14^{45}$ | Y. 330 | 300 | 60 | 1 |
| 176 | 49°31′ N. | 11°51′ W. | 1125 | 31-8-06 | $21^{35}$ | Y. 330 | 300 | 120 | 2 |
| 13 | 39°43′ N. | 17°30′ E. | > 1200 | 19-12-08 | $20^{50}$ | Y. 200 | 65 | 60 | 2 |
| 15 | 40°04′ N. | 19°06′ E. | 1000 | 22-12-08 | $5^{20}$ | Y. 200 | 1400 | 60 | 6 |
| 24 | 40°14′ N. | 12°23′ E. | > 3700 | 16-1-09 | $21^{10}$ $23^{15}$ | Y. 200 | 300—1600 | 30—240 | 1, 1 |
| 28 | 40°53′ N. | 13°43′ E. | 600 | 19-1-09 | $18^{40}$ | Y. 200 | 400 | 30 | 1 |
| 29 | 40°47′ N. | 12°55′ E. | 1550 | 20-1-09 | $21^{30}$ | Y. 200 | 600 | 60 | 6 |
| 31 | 41°44′ N. | 10°52′ E. | 1420 | 22-1-09 | $3^{50}$ | Y. 200 | 200 | 30 | 1 |
| 46 | 37°17′ N. | 6°00′ E. | > 1930 | 7-2-09 | $19^{30}$ | Y. 200 | 300 | 30 | 2 |
| 51 | 36°27′ N. | 0°37′ W. | > 2000 | 18-2-09 | $0^{50}$ | Y. 200 | 300 | 30 | 1 |
| 59 | 36°02′ N. | 4°24′ W. | 1260 | 21-2-09 | $1^{40}$ | Y. 200 | 500 | 30 | 1 |
| 65 | 35°53′ N. | 7°26′ W. | 1300 | 24-2-09 | $12^{20}$ | Y. 200 | 1600 | 120 | 1 |
| 106 | 36°33′ N. | 2°00′ W. | ca. 1100 | 25-6-10 | $0^{20}$ | Y. 200 | 1200 | 60 | 1 |
| 129 | 40°05′ N. | 11°31′ E. | 3420 | 12-7-10 | $4^{20}$ | Y. 200 | 1000 | 60 | 1 |
| 145 | 32°38′ N. | 19°02′ E. | 1925 | 25-7-10 | $4^{10}$ | Y. 200 | 300 | 30 | 3 |
| 182 | 38°13′ N. | 24°48′ E. | 500 | 14-8-10 | $23^{00}$ | Y. 200 | 600 | 30 | 1 |
| 192 | 38°07′ N. | 15°35′ E. | 652 | 20-8-10 | $22^{15}$ | Y. 200 | 600 | 30 | 1 |
| 206 | 39°32′ N. | 5°15′ E. | ca. 2860 | 28-8-10 | $1^{05}$ | Y. 200 | 300 | 15 | 1 |
| 210 | 41°10′ N. | 2°23′ E. | 780 | 30-8-10 | $3^{35}$ | Y. 200 | 600 | 30 | 1 |
| 232 | 36°28′ N. | 9°06′ W. | ca. 3500 | 9-9-10 | $23^{45}$ | Y. 200 | 2000 | 30 | 1 |
| "Dana" | | | | | | | | | |
| 1117 | 35°59′ N. | 5°30′ W. | 514 | 21-9-21 | $18^{15}$ | S. 200 | 300 | 120 | 2 |
| 1119 | 36°08′ N. | 0°30′ W. | 2800 | 23-9-21 | $21^{00}$ | S. 200 | 25 | 30 | 15 |
| 1122 | 37°12′ N. | 1°08′ E. | ? | 25-9-21 | $21^{30}$ | S. 200 | 100—200 | 120 | 2 |
| 1124 | 37°15′ N. | 2°55′ E. | ? | 27-9-21 | $3^{20}$ | S. 200 | 150 | 120 | 2 |
| 1128 | 36°46′ N. | 0°16′ E. | ? | 1-10-21 | $21^{50}$ | S. 200 | 500 | 60 | 4 |
| 4035 | 37°37′ N. | 5°06′ E. | 2700 | 21-4-30 | $23^{55}$ | S. 200 | 250 | 90 | 2 |
| 4036 | 38°28′ N. | 7°59′ E. | 2700 | 22-4-30 | $23^{55}$ | S. 200 | 200—150 | 90 | 1, 1, 1 |

| Station Nr. "Dana" | Lat. | Long. | Depth Metres | Date | Hour | Gear | Wire out Metres | Duration of haul in minutes | Number of specimens |
|---|---|---|---|---|---|---|---|---|---|
| 4043 | 37°30.5' N. | 11°30' E. | 300 | 25.4.30 | 1h | S. 200 | 150 | 5 | 2 |
| 4063 | 36°40' N. | 17°40' E. | 4250 | 12.5.30 | 20h | S. 200 | 300 | 90 | 1 |
| 4067 | 33°36' N. | 22°07' E. | 1000 | 18.5.30 | 3h | S. 150 | 950 | 90 | 1 |
| 4079 | 39°54' N. | 14°40' E. | 980–1100 | 24.5.30 | 21h–22h | S. 200 | 150 | 90 | 1 |
| 4080 | 40°20' N. | 14°16' E. | 1000 | 25.5.30 | 24h | S. 200 | 250 | 90 | 1 |
| 4107 | 40°28' N. | 14°15' E. | 1040–980 | 27–28.5.30 | 22h–0h–2h | S. 200 | 250 | 90 | 1 |
| " | " | " | " | " | " | S. 200 | 150 | 5 | 1 |
| [illegible] | | | | | | [illegible] | [illegible] | | [illegible] |
| 4119 | 40°13' N. | 12°06' E. | 3375 | 30.5.30 | 15h | E. 100 | 1000 | 45 | 1 |
| " | " | " | 2700 | " | 10h | S. 150 | 3000 | 120 | 1 |
| 4120 | 38°34' N. | 13°12' E. | 2000 | 31.5.30 | 22h | S. 200 | 250 | 90 | 2 |
| " | " | " | 1825 | " | " | S. 200 | 100 | 5 | 4 |
| 4121 | 38°22' N. | 13°01' E. | 980 | 1.6.30 | 0h | S. 200 | 100 | 120 | 3 |
| 4122 | 38°27' N. | 10°30' E. | 2000 | 1.6.30 | 20h | S. 200 | 200 | 90 | 1 |
| 4125 | 36°54' N. | 8°03' E. | 2640 | 5.6.30 | 2h | S. 200 | 250 | 90 | 1 |
| [illegible] | | | | | | [illegible] | [illegible] | | [illegible] |
| 4135 | 36°18' N. | 2°07' E. | 41 | 6.6.30 | 21h | S. 200 | 100 | 30 | 1 |
| 4136 | 36°06' N. | 0°16' W. | 2675 | 7.6.30 | 1h | S. 200 | 50 | 90 | 1 |

The length of the specimens varies from 9 to 25 mm., the numbers of chaetigers from 25 to 32. The head is broad and flat with 4 pointed tentacles, the first pair considerably longer than the second pair. One pair of black eyes. Three pairs of tentacular cirri; the first and second pair long and subulate, the third rudimentary at the base of the second pair. The species is easily known by the first two pairs of feet, which are much greater and stouter than the rest and directed sidewards, whereas the others are turned backwards. They carry 4–6 very strong, dark, curved hooks surrounded by a transparent membrane. The rest of the parapodia are distinctly set off from the first two pairs by a deep furrow. Their bristles have a fan shaped arrangement; they are all compound, the utmost joint is a broad, paddle-shaped blade finely denticulated on one of the edges. In fig. 7 the front end is shown, the proboscis being extended. In the middle of it and laterally are two small filiform papillae. In two specimens ("Dana", St. 4036,

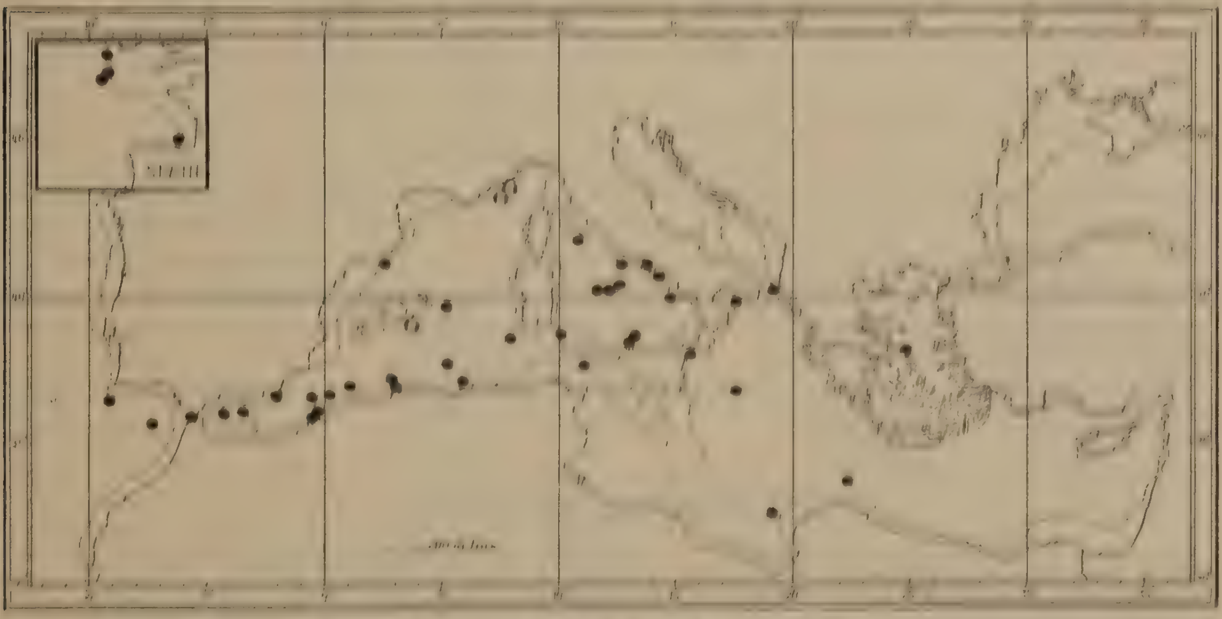

Chart 6. Occurrence of Lopadorhynchus uncinatus Fauvel.

● new records; ○ previous records.

and "Thor" 1909, St. 31) parasitic copepods were found, one of which is shown in fig. 6 adhering to the head; in the other specimen two similar parasites were fixed to the proboscis.

Fauvel (1915 and 1916) described this species from several localities in the Mediterranean, i. e. from the Balearic and the Ligurian Sea. Through the present material our knowledge of the distribution of *L. uncinatus* has been considerably enlarged. Chart 6 will show, that it is spread widely over all parts of the Mediterranean even in the Ægean Sea; the Levant is the only area from which it hitherto has not been recorded. Judging from this material there seems to be no doubt that this large and characteristic *Lopadorhynchus*-species is the commonest form of this genus in the Mediterranean.—

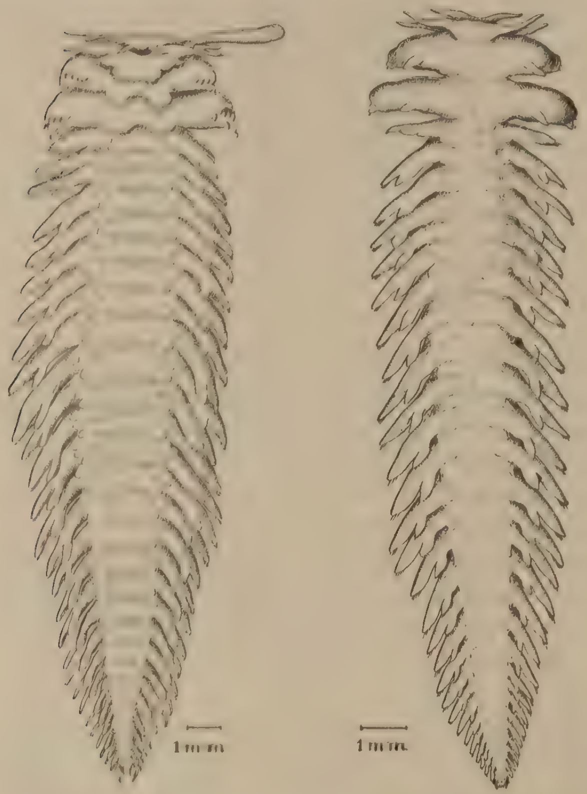

Fig. 6. *Lopadorhynchus uncinatus* Fauvel. Ventral and dorsal view. In the first figure a parasitic Copepod anteriorly.

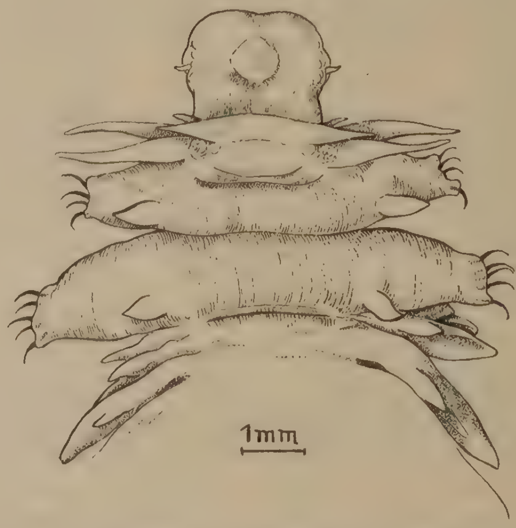

Fig. 7. *Lopadorhynchus uncinatus* Fauvel. Dorsal view of the anterior end.

Further, the material from the "Thor" contains specimens from the Atlantic; at two stations it has been taken in the Gulf of Cadiz and at a few stations rather close to each other in the waters S.W. and S. of Ireland; at these localities between the 1000 and 2000 m. line. As a rule the species is taken over great depths and thus is to be regarded as an oceanic form. As to its vertical distribution it seems to be most numerous in the first 100 to 300 m. from the surface. It seems furthermore to be present in adequate numbers in summer and winter.

Monro (1936, p. 113) reports the species for the first time from the South Atlantic, and Fauvel (1932) mentions it from the Indian Ocean.

## LOPADORHYNCHUS BREVIS Grube.

*Lopadorhynchus brevis* Grube 1855, p. 100.
*Lopadorhynchus brevis* Lo Bianco 1904, p. 52.
*Lopadorhynchus brevis* Ehlers 1913, p. 468.
*Lopadorhynchus brevis* Bergstrøm 1914, p. 181.
*Lopadorhynchus nans* Chamberlin 1919, p. 116.
*Lopadorhynchus brevis* Fauvel 1923, p. 184.
*Lopadorhynchus brevis* Monro 1930, p. 78.

## Material.

| Station Nr. | Lat. | Long. | Depth Metres | Date | Hour | Gear | Wire out Metres | Duration of haul in minutes | Number of specimens |
|---|---|---|---|---|---|---|---|---|---|
| **“Thor”** | | | | | | | | | |
| 10 | 37°21′ N. | 16°45′ E. | > 2100 | 15-12-08 | $15^{45}$ | Y. 200 | 600 | 60 | 1 |
| 11 | 36°57′ N. | 18°16′ E. | > 3700 | 16-12-08 | $9^{30}$ | Y. 200 | 300 | 120 | 1 |
| 12 | 39°34′ N. | 17°17′ E. | 1060 | 19-12-08 | $11^{40}$ | Y. 200 | 300 | 60 | 2 |
| 13 | 39°43′ N. | 17°30′ E. | > 1200 | 19-12-08 | $20^{50}$ | Y. 200 | 65 | 60 | 2 |
| 31 | 41°44′ N. | 10°52′ E. | 1420 | 22-1-09 | $3^{30}$ | Y. 200 | 200 | 30 | 1 |
| 144 | 34°31′ N. | 18°40′ E. | 3340 | 24-7-10 | $2^{00}$ | Y. 200 | 25 | 30 | 1 |
| 145 | 32°38′ N. | 19°02′ E. | 1925 | 25-7-10 | $4^{10}$ | Y. 200 | 300 | 30 | 1 |
| 147 | 31°35′ N. | 19°02′ E. | 960 | 25-7-10 | $19^{35}$ | D. 1 | 1200 | 180 | 1 |
| 187 | 37°54′ N. | 18°02′ E. | > 2500 | 18-8-10 | ? | ? | ? | 15 | 1 |
| 281 | 38°13′ N. | 15°36.5′ E. | 200 | 1-3-11 | ? | S. 100 | ? | 120 | 2 |
| **S/S “Pangan”** | | | | | | | | | |
| 297 | 33°10′ N. | 25°03′ E. | > 2000 | 25-6-11 | $23^{30}$ | S. 200 | 28 | 30 | 2 |
| **“Dana”** | | | | | | | | | |
| 1124 | 37°15′ N. | 2°55′ E. | ? | 27-9-21 | $3^{30}$ | S. 200 | 250 | 120 | 1 |
| 4034 | 37°12′ N. | 3°08′ E. | 2670 | 20-4-30 | $23^{15}$ | S. 200 | 100 | 90 | 1 |
| 4051 | 38°47′ N. | 14°04′ E. | 2250 | 4-5-30 | $3^{45}$ | S. 200 | 300 | 120 | 2 |
| 4054 | 38°00′ N. | 15°33′ E. | 1125 | 5-5-30 | $19^{30}$ | S. 200 | 150 | 90 | 1 |
| 4056 | 38°28′ N. | 15°38′ E. | 690 | 6-5-30 | $19^{30}$ | S. 200 | ? | 90 | 1 |
| 4059 | 35°59′ N. | 15°44′ E. | 1980 | 9-5-30 | $23^{30}$ | S. 200 | 100 | 90 | 1 |
| 4063 | 36°18′ N. | 18°20′ E. | 3850 | 13-5-30 | $3^{30}$ | S. 200 | 100 | 90 | 1 |
| 4065 | 35°22′ N. | 19°28′ E. | 3075 | 13-5-30 | $20^{30}$ | S. 200 | 300 | 90 | 1 |
| 4069 | 34°48′ N. | 22°26′ E. | 2900 | 15-5-30 | $23^{50}$ | S. 200 | 600 | 90 | 1 |
| 4071 | 36°59′ N. | 23°29′ E. | 710 | 18-5-30 | $1^{00}$ | S. 200 | 800 | 90 | 1 |
| » | » | » | 360 | » | » | S. 200 | 700 | » | 1 |
| 4076 | 38°28′ N. | 18°21′ E. | 2255 | 23-5-30 | $2^{10}$ | S. 200 | 100 | 90 | 1 |
| 4078 | 37°50′ N. | 15°32′ E. | 1550 | 24-5-30 | $2^{40}$ | S. 200 | 150 | 90 | 1 |
| 4079 | 39°54′ N. | 14°49′ E. | 680—1160 | 24-5-30 | $20^{30}$ $22^{30}$ | S. 200 | 200 | 90 | 1 |
| » | » | » | » | » | » | S. 200 | 100 | » | 2 |
| 4089 | 40°29′ N. | 14°16′ E. | 1000 | 26-5-30 | $23^{30}$ | S. 200 | 250 | 90 | 1 |
| 4107 | 40°28′ N. | 14°15′ E. | 1040—950 | 27/28-5-30 | $22^{45}$ $0^{45}$ $2^{45}$ | S. 200 | 200 | 90 | 1 |
| » | » | » | » | » | » | S. 200 | 150 | » | 1 |
| 4118 | 40°35′ N. | 13°40′ E. | 1480 | 29-5-30 | $22^{40}$ | S. 200 | 200 | 90 | 1 |
| 4119 | 40°13′ N. | 12°06′ E. | 3375 | 30-5-30 | $15^{30}$ | P. 100 | 1200 | 45 | 1 |
| » | » | » | » | » | » | P. 100 | 1000 | » | 1 |
| » | » | » | 3200 | » | $17^{30}$ | P. 100 | 800 | » | 2 |
| » | » | » | » | » | » | P. 100 | 600 | » | 1 |
| » | » | » | » | » | » | P. 100 | 400 | » | 1 |
| 4122 | 38°27′ N. | 10°20′ E. | 2000 | 1-6-30 | $20^{00}$ | S. 200 | 250 | 90 | 1 |
| » | » | » | » | » | » | S. 200 | 150 | » | 1 |
| 4124 | 37°24′ N. | 2°58′ E. | 2630 | 3-6-30 | $22^{40}$ | S. 200 | 200 | 90 | 1 |
| 4158 | 46°28′ N. | 8°01′ W. | 4550 | 18-6-30 | $1^{45}$ | S. 200 | 600 | 90 | 2 |

The specimens vary in size from abt. 3 to 15 mm. The colour is yellow, the body more or less transparent. In some specimens eyes are present, in others not.

One specimen was subjected to a special examination. It measures 10 mm. by 3.8 including the feet; number of chaetigers 25. The head is squared off anteriorly; on its ventral side it carries two small pointed antennæ and laterally two much longer. 3 pairs of tentacular cirri, the two anterior are very long, whereas the third is rather like a little appendage to the second pair. The first three pairs of feet have no ventral cirri, only dorsal ones, whereas the rest have

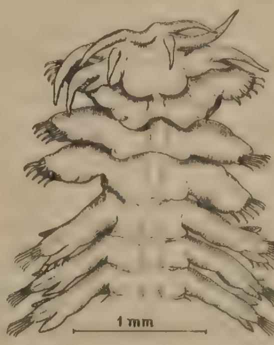

Fig. 8. *Lopadorhynchus brevis* Grube. Ventral view.

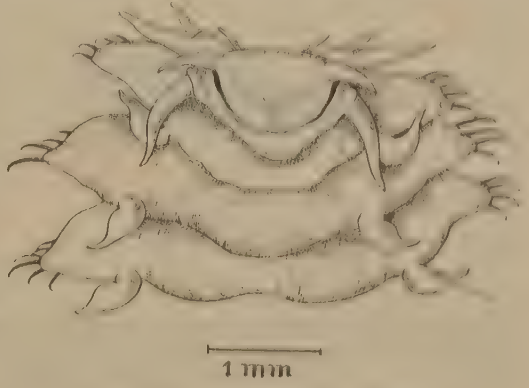

Fig. 9. *Lopadorhynchus brevis* Grube. Dorsal view.

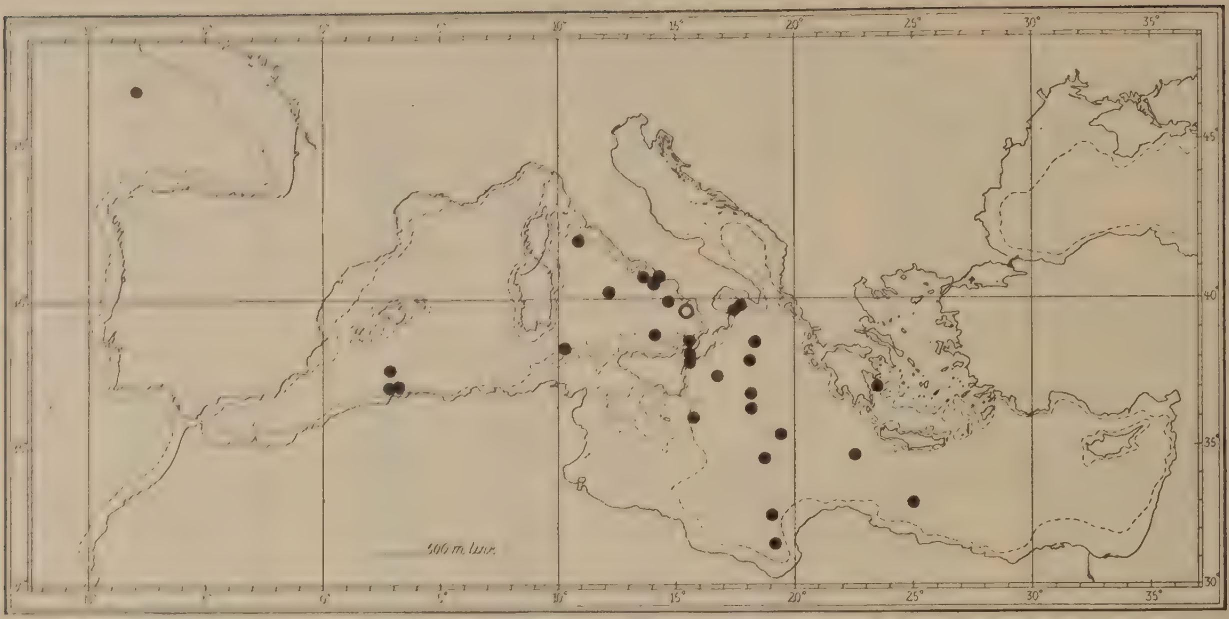

Chart 7. Occurrence of *Lopadorhynchus brevis* Grube.

● new records. ○ previous record.

ventral as well as dorsal cirri. The dorsal cirri are long and slender in the first three feet, in the rest they are pear-shaped. The first three feet differ considerably in shape from the following; they are stouter, shorter and set obliquely; the rest are long and slender. As to the arrangement of the bristles the following observations were made: 1. chaetiger: 8 simple bristles; 2. chaetiger: 6 do.; 3. chaetiger: 7 do.; 4. chaetiger: abt. 10 compound dorsal bristles and 8 simple ventral bristles; 5. chaetiger: abt. 30 compound and 4 simple bristles; 6. chaetiger: abt. 50 compound and 2 simple bristles; 10. chaetiger: 67 compound and 14. chaetiger: abt. 60 compound bristles; from the 6th chaetiger the number of simple bristles, only found in the ventral lobe, is two, one of which is situated in the midline of the foot, the other close to the ventral edge of the fan which is formed by the dorsal, compound bristles.

The genus was originally established by Grube on this species, which was found in the Museum of St. Petersburg, originating from the Mediterranean without any mentioned locality. Lo Bianco reports *L. brevis* from Capri and Ischia, both from rather considerable depths. In the material to hand the species comes from a few stations coinciding with these localities, viz. in the Tyrrhenian Sea and the Strait of Messina. The greater part of the finds is in the Ionian Sea. Only one find is outside the hitherto known area of distribution in European waters, viz. the "Dana", St. 4158, in the Bay of Biscay. The number of specimens at each station is very small, the species evidently being of no quantitative value whatever.—The greater part of the material from the "Thor" has been taken in winter time, whereas the "Dana" material originates from the summer; thus there is no seasonal variation in the frequence of the species. As to the bathymetrical distribution the species seems to be an oceanic form occurring in the first 10—300 m. from the surface.

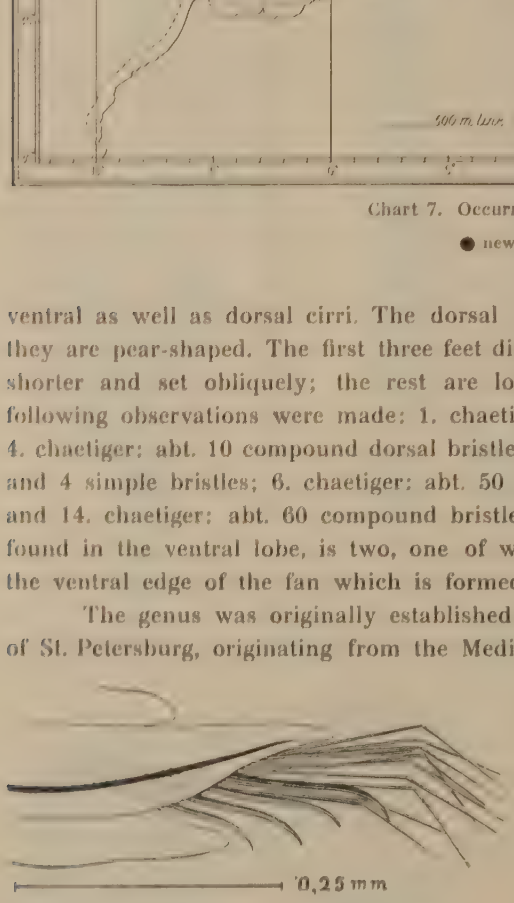

Fig. 10. *Lopadorhynchus brevis* Grube. 4th right parapodium.

Both Ehlers (1913) and Monro (1930) report *L. brevis* from the tropical parts of the Atlantic, and finally Chamberlin (1919) reports it from the Pacific: between Peru and Easter Island. This indicates a rather wide area of distribution for the species.

## LOPADORHYNCHUS KROHNII (Claparède).

*Hydrophanes Krohnii* Claparède 1870, p. 464.
*Lopadorhynchus viguieri* Reibisch 1895, p. 37.
*Lopadorhynchus viguieri* Ehlers 1913, p. 463.
*Lopadorhynchus Krohnii* Bergstrøm 1914, p. 180.
*Lopadorhynchus Krohnii* Fauvel 1923, p. 185.

### Material.

| Station Nr. | Lat. | Long. | Depth Metres | Date | Hour | Gear | Wire out Metres | Duration of haul in minutes | Number of specimens |
|---|---|---|---|---|---|---|---|---|---|
| **"Thor"** | | | | | | | | | |
| 160 | 35°59′ N. | 28°14′ E. | > 1000 | 1-8-10 | $3^{35}$ | Y. 200 | 1000 | 60 | 1 |
| **"Dana"** | | | | | | | | | |
| 4040 | 38°21′ N. | 9°24′ E. | 1975 | 24-4-30 | $2^{30}$ | S. 200 | 300 | 90 | 1 |
| 4067 | 33°36′ N. | 22°07′ E. | 1925 | 14-5-30 | $19^{50}$ | S. 200 | 200 | 90 | 1 |
| 4076 | 38°28′ N. | 18°21′ E. | 2255 | 23-5-30 | $2^{10}$ | S. 200 | 100 | 90 | 1 |
| 4078 | 37°50′ N. | 15°32′ E. | 1550 | 24-5-30 | $2^{40}$ | S. 200 | 150 | 90 | 1 |
| 4089 | 40°29′ N. | 14°16′ E. | 1000 | 26-5-30 | $23^{20}$ | S. 200 | 250 | 90 | 1 |

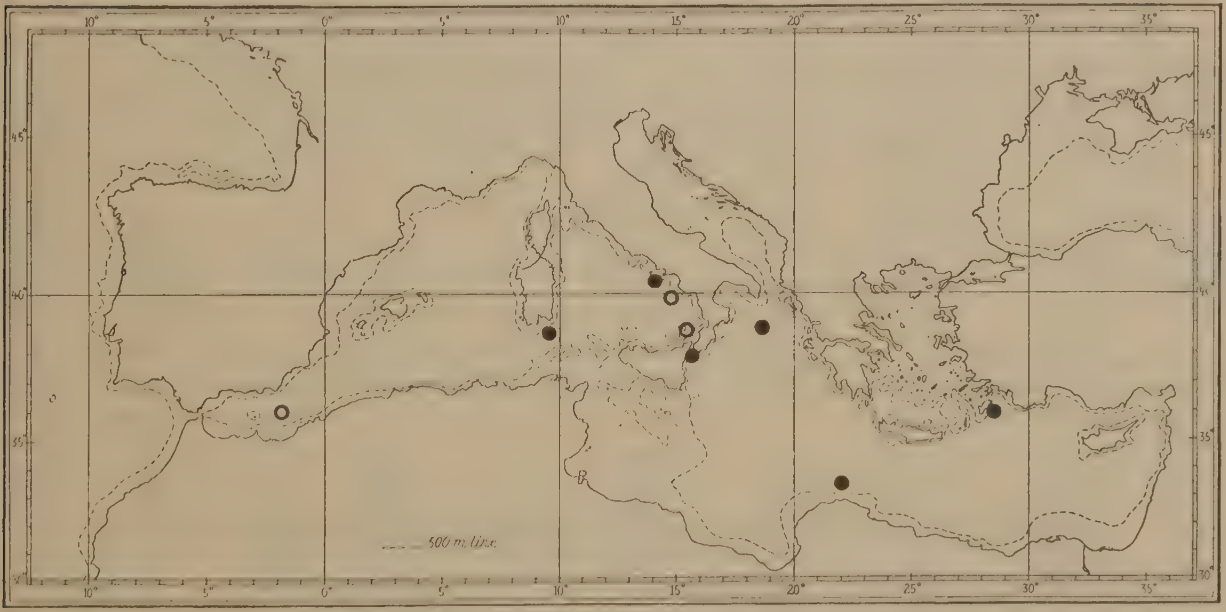

Chart 8. Occurrence of *Lopadorhynchus Krohnii* (Claparède).

● new records. ○ previous records.

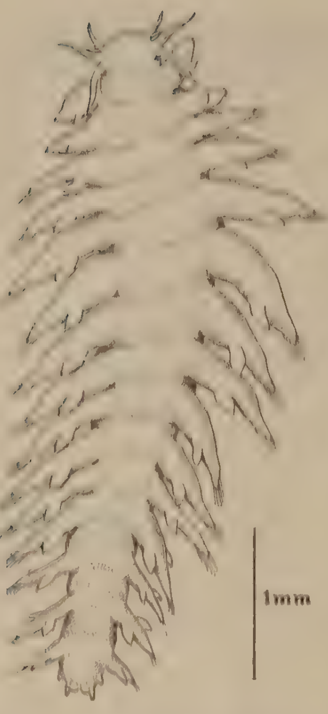

Fig. 11. *Lopadorhynchus Krohnii* (Claparède). Dorsal view.

This colourless, transparent and minute species only measures 2—5 mm. by less than 1 mm. The eyes are large and dark. The head is slightly curved anteriorly; it carries two pairs of subulate antennæ, the hindmost being the shorter. As far as could be ascertained only 2 pairs of tentacular cirri were present. In contradistinction to the two preceding *Lopadorhynchus*-species only the first two pairs of feet are differently shaped, they are stouter and shorter than the following and are turned laterally; they only have dorsal cirri and their bristles are all simple and slightly curved and present in a number of 5—6. In the following feet, all turned backwards and furnished with dorsal as well as ventral cirri, the numerous compound bristles are arranged so as to form a fan, in the ventral border of which one simple bristle is found.

This species also was originally described from the Mediterranean, viz. from Naples, Capri and Messina; Fauvel mentions it from Algeria. In the present material it originates from a few scattered localities; of special interest are the two finds in the eastern part of the Mediterranean. In the material here worked out this *Lopadorhynchus*-species is the one which has been taken farthest east. There is hardly any doubt that it is actually spread throughout the Mediterranean; on account of its small size it may however easily be overlooked. *L. Krohnii* seems to have a very wide distribution, as Reibisch reports it from the Atlantic in the neighbourhood of the equator and Ehlers from the Indian Ocean.

## LOPADORHYNCHUS (PROLOPADORHYNCHUS) NATIONALIS Reibisch.

*Lopadorhynchus nationalis* Reibisch 1895, p. 38.
*Lopadorhynchus nationalis* Ehlers 1913, p. 463.
*Prolopadorhynchus nationalis* Bergstrøm, 1914, p. 180.
*Lopadorhynchus nationalis* Fauvel 1916, p. 53.
*Lopadorhynchus (Prolopadorhynchus) nationalis* Fauvel 1923, p. 186.

Material.

| Station Nr. | Lat. | Long. | Depth Metres | Date | Hour | Gear | Wire out Metres | Duration of haul in minutes | Number of specimens |
|---|---|---|---|---|---|---|---|---|---|
| "Thor" | | | | | | | | | |
| 197 | 40°34′ N. | 13°36′ E. | > 1000 | 24-8-10 | $20^{00}$ | Y. 200 | 25 | 15 | 1 |
| S/S "Pangan" | | | | | | | | | |
| 207 | 33°10′ N. | 25°03′ E. | 2000 | 25-6-11 | $23^{30}$ | S. 200 | 28 | 30 | 2 |
| "Dana" | | | | | | | | | |
| 1124 | 37°15′ N. | 2°55′ E. | ? | 27-9-21 | $3^{30}$ | S. 200 | 250 | 120 | 1 |
| 4040 | 38°21′ N. | 0°24′ E. | 1975 | 24-4-30 | $2^{30}$ | S. 200 | 300 | 90 | 1 |
| 4050 | 38°48′ N. | 12°06′ E. | 1875 | 3-5-30 | $4^{00}$ | S. 200 | 150 | 90 | 1 |
| 4051 | 38°47′ N. | 14°04′ E. | 2830 | 3-5-30 | $19^{30}$ | S. 200 | 250 | 90 | 1 |
| 4055 | 38°12,5′ N. | 15°36′ E. | 225 | 6-5-30 | $3^{30}$ | S. 200 | 125 | 90 | 1 |
| 4056 | 38°28′ N. | 15°38′ E. | 690 —1100 | 6/7-5-30 | $19^{30}$ $3^{30}$ | S. 200 | 200 | 90 | 1, 1 |
| 4066 | 35°00′ N. | 20°04′ E. | 2840 | 14-5-30 | $3^{00}$ | S. 200 | 50 | 90 | 1 |

The species varies in size from 7—11 mm.; the number of chaetigers is abt. 25. The first three pairs of feet are stouter and shorter than the following. They carry dorsal as well as ventral cirri (the criterion

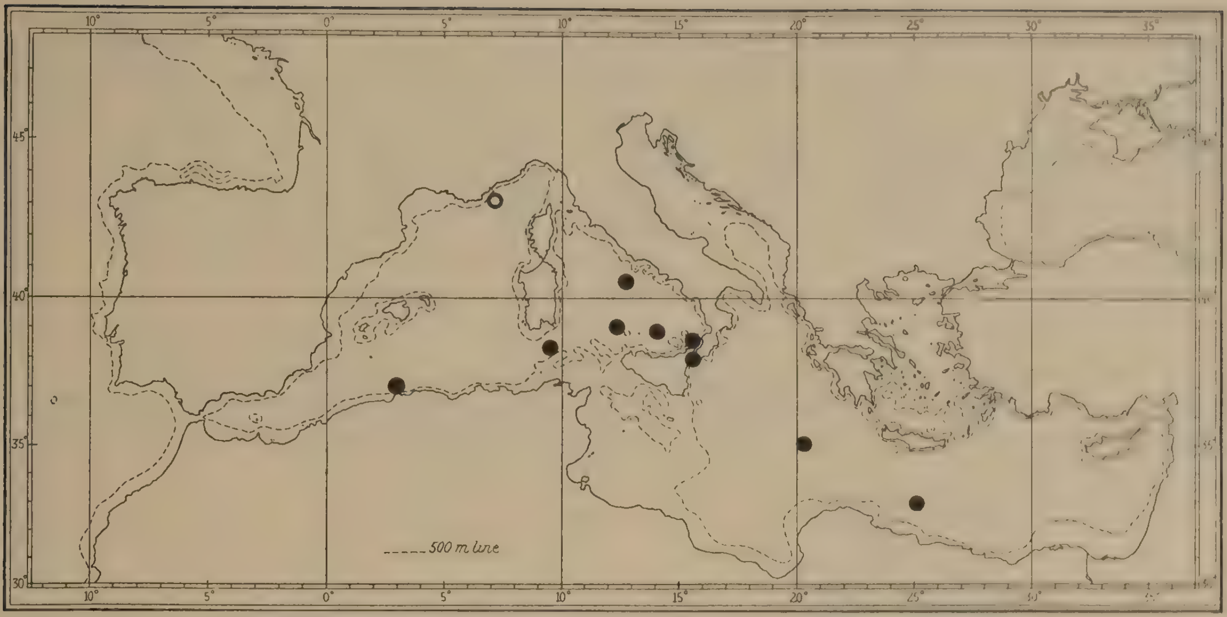

Chart 9. Occurrence of *Lopadorhynchus* (*Prolopadorhynchus*) *nationalis* Reibisch.

● new records. ○ previous record.

for the subgenus). Their bristles are all simple and rather slightly curved. In the fourth chaetiger the superior bristles are compound, the inferior (5—8) simple. In the following feet 1—2 simple bristles are found between the fan-shaped compound bristles.

Fauvel (1923) reports this species from the Mediterranean, viz. Monaco. A glance at the chart will show that actually it is widely distributed in this sea, from the Balearic Sea as far eastwards as the Levant. The species has only been dredged in the months from April to September, not once during the winter cruise. According to Fauvel (1916) it is a surface form; the present material supports this, as the length of the wire of the stramin net used was rather short (25—300 m.).

The species was originally described by Reibisch from the tropical area of the Atlantic, where according to this author and later Ehlers it was found between 28° N. Lat. and 10° S. Lat. Furthermore, Fauvel (1916) mentions it from between the Canary Islands and the Azores.

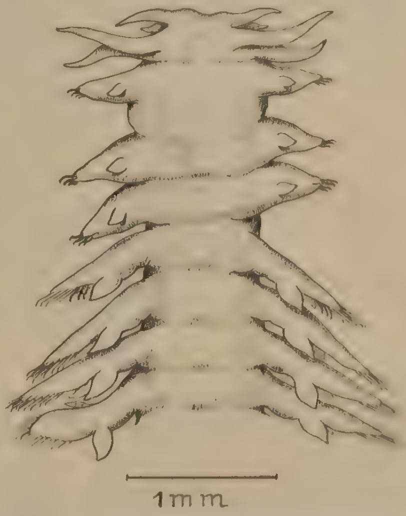

Fig. 12. *Lopadorhynchus* (*Prolopadorhynchus*) *nationalis* Reibisch. Dorsal view.

## LOPADORHYNCHUS (PROLOPADORHYNCHUS) APPENDICULATUS Southern.

*Lopadorhynchus appendiculatus* Southern 1909, p. 7.

*Prolopadorhynchus appendiculatus* Bergstrøm 1914, p. 179

*Lopadorhynchus appendiculatus* Fauvel 1916, p. 55.

*Lopadorhynchus* (*Prolopadorhynchus*) *appendiculatus* Fauvel 1923, p. 187.

Material.

| Station Nr. | Lat. | Long. | Depth Metres | Date | Hour | Gear | Wire out Metres | Duration of haul in minutes | Number of specimens |
|---|---|---|---|---|---|---|---|---|---|
| "Thor" | | | | | | | | | |
| 176 | 49°31′ N. | 11°51′ W. | 1125—1070 | 31-8-06 | $21^{30}$ | Y. 330 | 300 | 120 | 1 |
| 15 | 40°04′ N. | 19°06′ E. | 1000 | 22-12-08 | $8^{00}$ | Y. 200 | 1400 | 60 | 1 |
| 24 | 40°14′ N. | 12°23′ E. | > 3700 | 16-1-09 | $21^{10}$ | Y. 200 | 300 | 30 | 1 |
| 45 | 37°28′ N. | 8°18′ E. | > 2150 | 6-2-09 | $23^{25}$ | Y. 200 | 300 | 30 | 1 |
| 46 | 37°17′ N. | 6°00′ E. | > 1930 | 7-2-09 | $20^{20}$ | Y. 200 | 65 | 30 | 1 |
| 141 | 36°42′ N. | 13°34′ E. | 530 | 20-7-10 | $22^{35}$ | Y. 200 | 25 | 120 | 1 |
| "Dana" | | | | | | | | | |
| 4019 | 33°08′ N. | 10°22′ W. | 4125 | 30-3-30 | $18^{30}$ | S. 200 | 300 | 120 | 1 |

Only seven small specimens (4—13 mm.) are present from seven different localities. Under the microscope the species is easily distinguished from the other *Lopadorhynchus*-species by the long filiform appendage of the ventral cirri. The first two feet are stouter and a little shorter than the rest and have only simple, strongly curved, short bristles; the third foot has numerous compound and a few (4—6) curved, simple bristles; the rest have only compound bristles. All feet have both dorsal and ventral cirri. In three specimens pigmented eyes, in five specimens ripe ova in the feet were found.

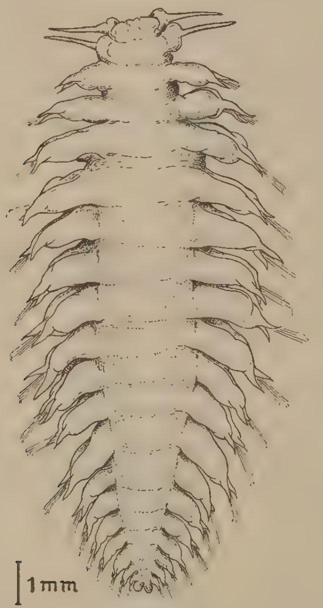

Fig. 13. *Lopadorhynchus (Prolopadorhynchus) appendiculatus* Southern. Dorsal view.

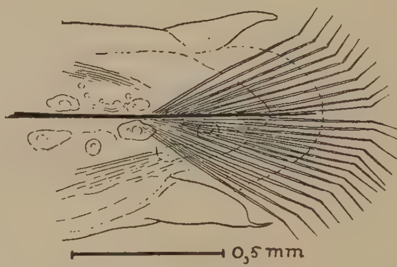

Fig. 14. *Lopadorhynchus (Prolopadorhynchus) appendiculatus* Southern. 4th right parapodium.

The species was originally described from Irish waters (W. and S.W. of Ireland). In the present material also one finding place is situated inside this area, viz. "Thor" St. 176, 1906. Furthermore, FAUVEL (1916) reports it from the Atlantic: Gibraltar, the Azores, the Canary Islands, and in conformity with this we find in the present material a specimen from the waters west of Casablanca. Finally, FAUVEL reports the species from the western part of the Mediterranean, viz. off Monaco and from the Alboran Sea. In the material here worked out the area of distribution of the species in the Mediterranean is found to be considerably wider than hitherto known, as it has been found both in the Tyrrhenian and the Balearic Sea (off the coast of Algeria) as well as in the Sidra Sea (between Sicily and Tunis). As to the bathymetric distri-

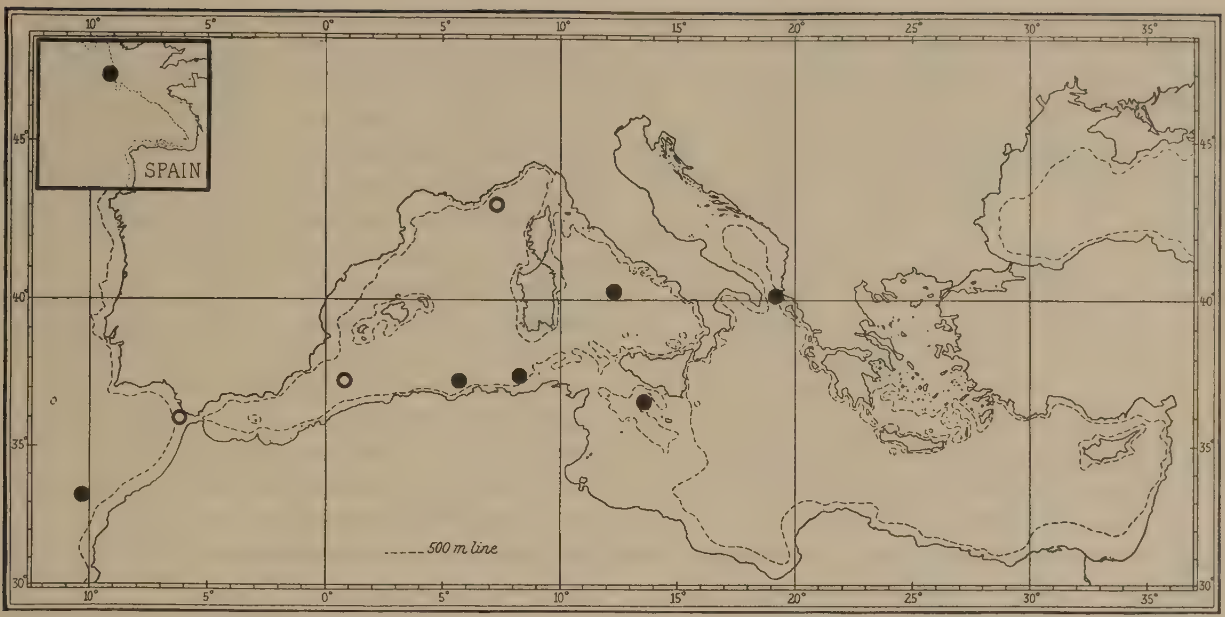

Chart 10. Occurrence of *Lopadorhynchus* (*Prolopadorhynchus*) *appendiculatus* Southern.
● new records. ○ previous records.

bution the species seems to be a surface form living over great depths. It has been dredged in wintertime as well as in the summer months. At all the places only one specimen has been taken; it seems to be of no quantitative value; evidently the species is a rarity.

## MAUPASIA COECA Viguier.

*Maupasia coeca* Viguier 1886, p. 382.
*Maupasia coeca* var. *atlantica* Southern 1909, p. 4.
*Maupasia coeca* Ehlers 1912, p. 15.
*Maupasia coeca* Ehlers 1913, p. 462.
*Maupasia coeca* Fauvel 1916, p. 63.
*Maupasia coeca* Fauvel 1923, p. 190.

Material.

| Station Nr. | Lat. | Long. | Depth Metres | Date | Hour | Gear | Wire out Metres | Duration of haul in minutes | Number of specimens |
|---|---|---|---|---|---|---|---|---|---|
| "Thor" | | | | | | | | | |
| 106 | 36°33′ N. | 2°00′ W. | ca. 1100 | 25-6-10 | $2^{30}$ | Y. 200 | 65 | 30 | 1 |
| 112 | 36°56′ N. | 2°15′ E. | 2700 | 27-6-10 | $0^{15}$ | Y. 200 | 300 | 30 | 1 |
| 132 | 38°57′ N. | 9°47′ E. | 1227 | 14-7-10 | $4^{50}$ | Y. 200 | 600 | 30 | 1 |
| 225 | 36°35′ N. | 3°00′ W. | 200 | 6-9-10 | $3^{30}$ | Y. 200 | 25 | 15 | 3 |
| "Dana" | | | | | | | | | |
| 4136 | 36°06′ N. | 0°16′ W. | 2500 | 7-6-30 | $1^{45}$ | E. 300 | 1000 | 90 | 2 |
| » | » | » | » | » | » | S. 200 | 50 | » | 2 |
| 4139 | 36°21′ N. | 3°06′ W. | 850 | 8-6-30 | $1^{15}$ | S. 200 | 100 | 90 | 1 |

This small species only measures 3—5 mm. and the number of segments is abt. 15. The body is flattened and broad and the species may easily be distinguished by the heart-shaped, foliaceous dorsal cirri and the lanceolate ventral cirri which end in a long point. The bristles are all compound and very characteristic by their distinct heterogomphy.

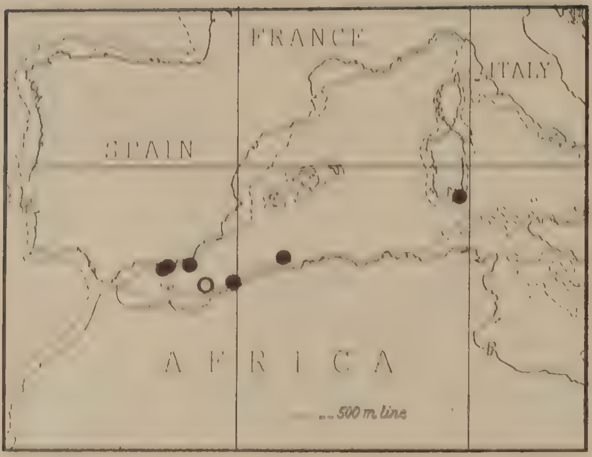

Chart 11. Occurrence of *Maupasia coeca* Viguier.
● new records. ○ previous record.

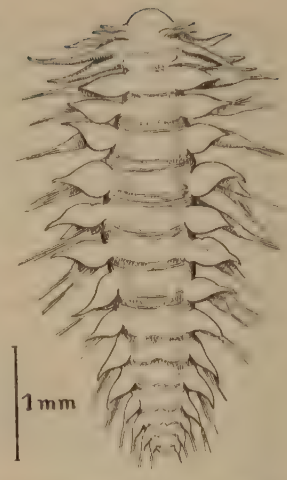

Fig. 15. *Maupasia coeca* Viguier. Dorsal view.

The species was originally described from the Mediterranean, viz. the Gulf of Algeria. In the present material the species was found off the coast of Spain in the Alboran Sea and off Algeria. Another finding place is south of C. Carbonara in Sardinia. All the stations are from the summer cruises; everywhere the species has been taken at the surface or in the upper water-layers. It seems to be rare, as all the samples only contain one or some few specimens. — *Maupasia coeca* seems to be widely distributed. In the Atlantic it is known from the coast of Ireland (Southern 1909) and off C. Finisterre (Fauvel 1916). Finally Ehlers (1912 and 1913) reports it from Antarctis and the equatorial area of the Atlantic.

## Family TYPHLOSCOLECIDAE Uljanin.

Only one of the three genera *Typhloscolex*, *Sagitella* and *Travisiopsis* hitherto known from the Mediterranean is present in the material, viz. Travisiopsis. As seen below the specific identification of the Mediterranean examples is problematic. The Lusitanian area still harbours two other species, *T. Levinseni* and *T. lobifera* besides the one *T. lanceolata* reported here.

### TRAVISIOPSIS LANCEOLATA Southern.

*Travisiopsis lanceolata* Southern 1910, p, 428.
*Travisiopsis lanceolata* Southern 1911, p. 30.
*Travisiopsis lanceolata* Fauvel 1916, p. 75.
*Travisiopsis lanceolata* Fauvel, 1923, p. 229.
*Travisiopsis lanceolata* Wesenberg-Lund, E. 1935, p. 11.

Material.

| Station Nr. | Lat. | Long. | Depth Metres | Date | Hour | Gear | Wire out Metres | Duration of haul in number | Number of specimens |
|---|---|---|---|---|---|---|---|---|---|
| "Thor" | | | | | | | | | |
| 62 | 50°25′ N. | 12°44′ W. | 2775 | 5-6-06 | $2^{45}$ | Y. 330 | 1500 | 120 | 1 |
| 74 | 49°23′ N. | 12°13′ W. | 1245—1298 | 10-6-06 | $6^{35}$ | Y. 330 | 2000 | 60 | 2 |
| 180 | 48°19′ N. | 13°53′ W. | > 4000 | 3-9-06 | $17^{05}$ | Y. 330 | 1800 | 60 | 2 |
| 181 | 49°22′ N. | 12°52′ W. | 1350 | 4-9-06 | $10^{35}$ | Y. 330 | 1800 | 60 | 2 |
| "Dana" | | | | | | | | | |
| 4070 | 35°40.5′ N. | 21°54′ E. | 3950 | 17-5-30 | $5^{45}$ | P. 100 | 400 | 60 | 1 |
| 4119 | 40°13′ N. | 12°06′ E. | 3375 | 30-5-30 | $15^{30}$ | P. 100 | 1000 | 45 | 1 |
| 4158 | 46°28′ N. | 8°01′ W. | 4550 | 18-6-30 | $1^{45}$ | S. 200 | 600 | 90 | 10 |

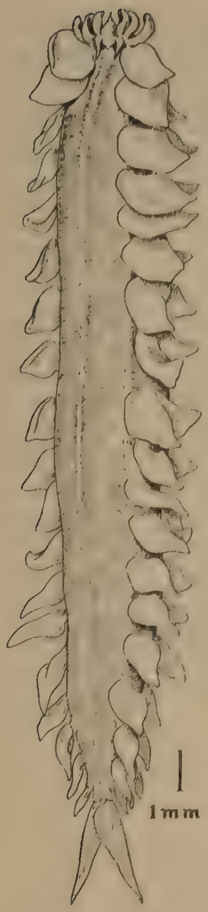

Fig. 16. *Travisiopsis lanceolata* Southern. Laterodorsal view.

The species is transparent, cylindrical with pointed ends, and of a slightly yellow colour. It measures 20—30 mm. in length by 2—3 mm. The dorsal and ventral cirri from the middle part of the body are almost square; towards the hindmost end they become oblong and the anal cirri are lanceolate, each supported down the middle by a kind of hyaline ridge.

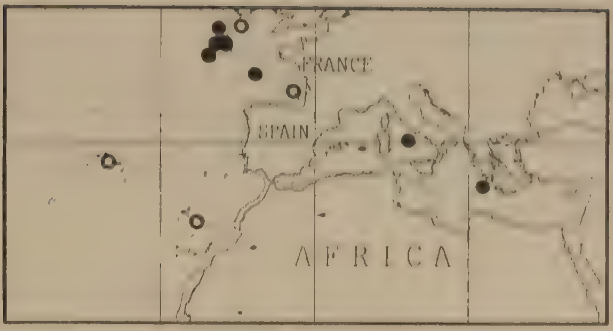

Chart 12. Occurrence of *Travisiopsis lanceolata* Southern.
● new records. ○ previous records.

The localities published here (S. of Ireland and the Bay of Biscay) coincide with the hitherto known area of distribution of this species, since Southern reports it from the coast of Ireland, and Fauvel from the Gulf of Gascogne. The two specimens from the Mediterranean—Tyrrhenian and Ionian Seas—are unfortunately in a very bad state of preservation, the heads are damaged and the cirri have fallen off except the anal cirri; it is exclusively on account of the shape of these latter that I venture to refer the specimens to *T. lanceolata* South. The species is a pronounced pelagic, oceanic form with wide distribution in the Atlantic (the Azores, the Canary Islands; it penetrates further northwards than any other of the species of this genus, i. e. to the waters south of Iceland). It was hitherto not known from the Mediterranean, and it is regrettable that the identification of these two specimens is doubtful.

## Family ALCIOPIDAE Ehlers.

The Alciopidae are exclusively pelagic forms of crystalline transparency often with regularly arranged pigment spots. They may attain considerable lengths, but are often small or moderate in size. Highly characteristic is the enormous development of the eyes, which are most commonly orange-coloured or red, widely protruding on either side of the head. The prostomium is ordinarily small; it carries 4 paired antennæ and one unpaired. The number of tentacular cirri is varying. The first chaetigers are in some genera more or less rudimentary. The parapodia are all uniramous with foliaceous noto- and neurocirri. In some genera the pedal lobe ends in one or even two cirriform appendages. The setæ may be all simple or all composite, or both types may be present, just as hirsute as well as crochet-like setæ may occur. The proboscis reaches in some genera an enormous development; it may be provided with lateral processes often of a considerable size, or with a number of small papillary protrusions. Segmental glands are present; when filled with excreta they are very conspicuous and almost always strongly dark-pigmented. In some genera the notocirri of the first feet are transformed into seminal pouches.

The family belongs to the large, open oceans, and is best known from the Atlantic and the Mediterranean (Plankton-Expedition der Humboldt Stiftung and the expeditions of the Prince of Monaco).

On an average the Alciopids are fairly poorly represented in the collections made by the different exploring expeditions, a fact which primarily may be due to their scarcity but no less to the difficulty of preserving them. They are ordinarily extremely delicate and fragile, and the rough treatment to which the samples often are subjected—e. g. when placed in formaline without preceding preparation—may cause them to fall into lots of fragments, frequently only consisting of a few segments.

The present collections are comparatively rich; they contain almost all that we à priori should expect to find. Only the *Rhynchonerella fulgens* Greeff and the *Callizona setosa* (Greeff) are not present. Special interest is attached to *Greeffia oahuensis* McIntosh which was not hitherto known from the areas here under consideration.

## TORREA CANDIDA (delle Chiaje).

*Liocapa vertebralis* Costa 1864, p. 165.
*Torrea vitrea* Quatrefages 1865, p. 159.
*Liocapa candida* Levinsen 1885, p. 333.
*Alciopa vittata* Hering 1892, p. 747.
*Asterope candida* Apstein 1900, p. 7.
*Asterope candida* Lo Bianco 1904, p. 50.
*Asterope candida* Fauvel 1916, p. 65.
*Asterope candida* Fauvel 1923, p. 202.
*Torrea candida* Monro 1930, p. 82.
*Asterope candida* Fauvel 1932, p. 16.
*Torrea candida* Monro 1936, p. 119.

Material.

| Station Nr. "Thor" | Lat. | Long. | Depth Metres | Date | Hour | Gear | Wire out Metres | Duration of haul in minutes | Number of specimens |
|---|---|---|---|---|---|---|---|---|---|
| 11 | 36°57′ N. | 18°16′ E. | > 3700 | 16-12-08 | $5^{25}$ | Y. 200 | 65 | 60 | 1 |
| 23 | 40°34′ N. | 13°24′ E. | 1800 | 15-1-09 | $23^{50}$ | Y. 200 | 25 | 30 | 2 |
| 25 | 40°34′ N. | 13°24′ E. | > 1800 | 17-1-09 | $16^{40}$ | Y. 200 | 65 | 30 | 3 |
| 30 | 41°15′ N. | 11°55′ E. | > 1800 | 21-1-09 | $5^{30}$ | Y. 200 | 65 | 60 | 2 |
| 30 | » | » | » | » | $7^{10}$ | Y. 200 | 300 | » | 1 |
| 39 | 39°41′ N. | 10°02′ E. | 1750 | 1-2-09 | $5^{00}$ | Y. 200 | 25 | 60 | 2 |
| » | » | » | » | » | $6^{10}$ | Y. 200 | 65 | » | 5 |
| 43 | 38°14′ N. | 8°42′ E. | > 2000 | 3-2-09 | $6^{15}$ | Y. 200 | 65 | 30 | 2 |
| 45 | 37°28′ N. | 8°18′ E. | > 2150 | 6-2-09 | $23^{25}$ | Y. 200 | 300 | 30 | 1 |
| 46 | 37°17′ N. | 6°00′ E. | > 1930 | 7-2-09 | $20^{20}$ | Y. 200 | 65 | 30 | 2 |
| 47 | 36°55′ N. | 3°12′ E. | > 2000 | 10-2-09 | $22^{20}$ | Y. 200 | 65 | 30 | 2 |
| 69 | 36°13′ N. | 9°44′ W. | > 3500 | 28-2-09 | $23^{40}$ | Y. 200 | 300 | 30 | 1 |
| 106 | 36°33′ N. | 2°00′ W. | ca. 1100 | 25-6-10 | $2^{30}$ | Y. 200 | 65 | 30 | 1 |
| 107 | 36°18′ N. | 1°14′ W. | ca. 2250 | 25-6-10 | $9^{05}$ | Y. 200 | 300 | 30 | 1 |
| 112 | 36°56′ N. | 2°15′ E. | 2700 | 27-6-10 | $1^{05}$ | Y. 200 | 65 | 15 | 1 |
| 115 | 38°17′ N. | 4°11′ E. | 2800 | 28-6-10 | $23^{20}$ | Y. 200 | 300 | 30 | 2 |
| » | » | » | » | 29-6-10 | $1^{20}$ | Y. 200 | 65 | 15 | 1 |
| » | » | » | » | » | $1^{40}$ | Y. 200 | 25 | » | 4 |
| 116 | 39°27′ N. | 5°26′ E. | 2860 | 30-6-10 | $2^{30}$ | Y. 200 | 65 | 30 | 2 |
| » | » | » | » | » | $3^{00}$ | Y. 200 | 25 | 15 | 2 |
| 118 | 41°00′ N. | 6°43′ E. | > 2700 | 30-6-10 | $22^{55}$ | Y. 200 | 300 | 30 | 1 |
| » | » | » | » | 1-7-10 | $0^{30}$ | Y. 200 | 25 | 15 | 5 |
| 120 | 40°05′ N. | 11°31′ E. | 3420 | 12-7-10 | $3^{00}$ | Y. 200 | 25 | 30 | 1 |
| 132 | 38°57′ N. | 9°47′ E. | 1227 | 14-7-10 | $3^{05}$ | Y. 200 | 25 | 30 | 2 |
| 134 | 37°37′ N. | 10°17′ E. | 350 | 15-7-10 | $4^{50}$ | Y. 200 | 25 | 30 | 2 |
| 144 | 34°31′ N. | 18°40′ E. | 3340 | 24-7-10 | $2^{00}$ | Y. 200 | 25 | 30 | 1 |
| » | » | » | » | » | $9^{00}$ | Y. 200 | 25 | » | 1 |
| 147 | 31°35′ N. | 19°02′ E. | 993 | 25-7-10 | $23^{35}$ | Y. 200 | 25 | 30 | 1 |
| 160 | 35°59′ N. | 28°14′ E. | > 1000 | 1-8-10 | $2^{00}$ | Y. 200 | 25 | 30 | 1 |
| 182 | 38°13′ N. | 21°18′ E. | 500 | 14-8-10 | $23^{00}$ | Y. 200 | 10 | 15 | 1 |
| 193 | 38°15′ N. | 15°39′ E. | > 100 | 21-8-10 | $0^{50}$ | Y. 200 | 10 | 30 | 4 |
| 194 | 38°33′ N. | 15°29′ E. | 1140 | 21-8-10 | $4^{30}$ | Y. 200 | 10 | 15 | 4 |
| » | » | » | » | » | $5^{00}$ | Y. 200 | 25 | » | 6 |
| » | » | » | » | » | $6^{00}$ | Y. 200 | 1200 | 30 | 1 |
| 195 | 39°02′ N. | 14°55′ E. | ca. 3160 | 21-8-10 | $18^{10}$ | Y. 200 | 300 | 30 | 3 |
| » | » | » | » | » | $18^{50}$ | Y. 200 | 65 | 15 | 2 |
| 196 | 39°59′ N. | 11°31′ E. | > 600 | 22-8-10 | $2^{40}$ | Y. 200 | 25 | 30 | 10 |
| 199 | 39°32′ N. | 10°49′ E. | ca. 2700 | 25-8-10 | $21^{00}$ | Y. 200 | 25 | 15 | 2 |
| 200 | 39°18′ N. | 10°11′ E. | > 2000 | 26-8-10 | $3^{45}$ | Y. 200 | 25 | 30 | 3 |
| 206 | 39°32′ N. | 5°15′ E. | ca. 2860 | 28-8-10 | $0^{30}$ | Y. 200 | 25 | 15 | 1 |
| » | » | » | » | » | $1^{40}$ | Y. 200 | 1000 | 45 | 2 |
| » | » | » | » | » | $3^{05}$ | Y. 200 | 2000 | » | 2 |
| 210 | 41°10′ N. | 2°23′ E. | 780 | 30-8-10 | $2^{45}$ | Y. 200 | 25 | 30 | 1 |
| 216 | 38°31′ N. | 1°24′ E. | > 85 | 1-9-10 | $5^{10}$ | Y. 200 | 25 | 30 | 1 |

| Station Nr. | Lat. | Long. | Depth Metres | Date | Hour | Gear | Wire out Metres | Duration of haul in minutes | Number of specimens |
|---|---|---|---|---|---|---|---|---|---|
| **"Thor"** | | | | | | | | | |
| 217 | 38°01′ N. | 1°48′ E. | > 2000 | 1-9-10 | $13^{40}$ | Y. 200 | 300 | 15 | 1 |
| 220 | 36°25′ N. | 0°42′ E. | > 350 | 4-9-10 | $2^{15}$ | Y. 200 | 25 | 30 | 1 |
| 224 | 36°33′ N. | 2°00′ W. | > 950 | 5-9-10 | $10^{00}$ | Y. 200 | 300 | 15 | 3 |
| 227 | 36°33′ N. | 4°25′ W. | 99 | 6-9-10 | $17^{55}$ | Y. 200 | 25 | 30 | 2 |
| 282 | 38°12′ N. | 15°37′ E. | 200 | 8-3-11 | $21^{00}$ $22^{45}$ | S. 100 | 10 | 90 180 | 2 |
| **S/S "Pangan"** | | | | | | | | | |
| 298 | 34°20′ N. | 21°10′ E. | > 2000 | 26-6-11 | $23^{00}$ | S. 200 | 38 | 30 | 1 |
| **"Dana"** | | | | | | | | | |
| 1108 | 35°11′ N. | 8°28′ W. | ? | 14-9-21 | $20^{15}$ | Y. 200 | 300 | 120 | 6 |
| 1119 | 36°08′ N. | 0°30′ W. | 2800 | 23-9-21 | $21^{00}$ | S. 200 | 25 | 30 | 6 |
| 1120 | 36°24′ N. | 1°00′ W. | ? | 24-9-21 | $4^{40}$ | S. 200 | 250 | 120 | 2 |
| 1121 | 36°38′ N. | 2°00′ W. | 950 | 24-9-21 | $11^{15}$ | S. 200 | 25 | 30 | 1 |
| 1122 | 37°12′ N. | 1°08′ E. | ? | 25-9-21 | $21^{00}$ | S. 200 | 100 | 120 | 2 |
| 1124 | 37°15′ N. | 2°55′ E. | ? | 27-9-21 | $3^{20}$ | S. 200 | 100—200 | 120 | 2 |
| 4026 | 35°41′ N. | 2°51′ W. | 410 | 10-4-30 | $10^{10}$ | S. 200 | 200 | 60 | 4 |
| 4027 | 35°50′ N. | 2°55′ W. | 930—860 | 10/11-4-30 | $22^{40}$ $0^{15}$ | S. 200 | 100 | 60 | 6 |
| 4031 | 36°42′ N. | 1°16.5′ E. | 2250—2400 | 13-4-30 | $3^{00}$ | S. 200 | 100 300 400 | 90 | 4 |
| 4032 | 36°48′ N. | 3°06′ E. | 50—60 | 13-4-30 | $17^{15}$ | S. 200 | 50 | 30 | 1 |
| 4034 | 37°12′ N. | 3°08′ E. | 2760—2670 | 20-4-30 | $21^{15}$ $23^{15}$ | S. 200 | 50—250 | 90 | 1 |
| 4035 | 37°37′ N. | 5°06′ E. | 2710 | 21-4-30 | $19^{00}$ | S. 200 | 50—100—150 | 90 | 4 |
| 4036 | 38°28′ N. | 7°59′ E. | 2700 | 22-4-30 | $23^{00}$ | S. 200 | 50—100—150 | 90 | 4 |
| 4040 | 38°21′ N. | 9°24′ E. | 1830—1950 | 23/24-4-30 | $20^{15}$—$0^{30}$ | S. 200 | 50 150<br>200 250 | 90 | 6 |
| 4043 | 37°30.5′ N. | 11°00′ E. | 310—320—225 | 24/25-4-30 | $22^{00}$ $0^{00}$ | S. 200 | 100, 150,<br>250, 300 | 90 | 46 |
| 4044 | 37°24.5′ N. | 11°01′ E. | 255 | 25-4-30 | $2^{45}$ | S. 200 | 100, 150, 200 | 90 | 40 |
| 4045 | 37°04′ N. | 10°35′ E. | 118 | 25-4-30 | $9^{45}$ | S. 200 | 25, 50 | 60 | 4 |
| 4046 | 36°54′ N. | 10°25′ E. | 54 | 25-4-30 | $13^{10}$ | S. 200 | 25, 50 | 60 | 6 |
| 4047 | 37°05′ N. | 10°35′ E. | 95 | 1-5-30 | $20^{00}$ | S. 200 | 25, 50 | 60 | 4 |
| 4048 | 37°42′ N. | 11°22′ E. | 625—550<br>610—600 | 2-5-30 | $3^{15}$ | S. 200 | 150, 250,<br>350, 450 | 120 | 52 |
| 4050 | 38°48′ N. | 12°06′ E. | 2190—<br>2370—1950 | 2/3-5-30 | $16^{30}$—$2^{00}$—<br>$4^{00}$ | S. 200 | 50, 200, 300,<br>1000, 3000 | 90 | 5 |
| 4051 | 38°47′ N. | 14°04′ E. | 1860 | 3-5-30 | $23^{40}$ | S. 200 | 200, 250 | 90 | 6 |
| 4052 | 39°04′ N. | 15°29′ E. | 2010—1825 | 5-5-30 | $3^{15}$ | S. 200 | 100, 150,<br>200, 250 | 90 120 | 25 |
| 4054 | 38°00′ N. | 15°33′ E. | 625—775 | 6-5-30 | $1^{00}$ | S. 200 | 50, 100, 125 | 90 | 12 |
| 4055 | 38°12.5′ N. | 15°36′ E. | 175—125 | 6-5-30 | $5^{00}$ | S. 200 | 100, 125 | 90 | 5 |
| 4056 | 38°28′ N. | 15°38′ E. | 690—1100 | 6/7-5-30 | $19^{00}$—$3^{20}$ | S. 200 | 50, 100, 150,<br>200, 250 | 90 | 12 |
| 4060 | 36°47′ N. | 15°21′ E. | 1220 | 10-5-30 | $23^{00}$ | S. 200 | 50 | 90 | 10 |
| 4062 | 36°40′ N. | 17°40′ E. | 3250 | 12-5-30 | $20^{00}$ | S. 200 | 100 | 90 | 14 |
| 4063 | 36°18′ N. | 18°20′ E. | 3850 | 13-5-30 | $3^{00}$ | S. 200 | 200 | 90 | 16 |
| 4066 | 35°00′ N. | 20°04′ E. | 2840 | 14-5-30 | $3^{00}$ | S. 200 | 200 | 90 | 10 |
| 4067 | 33°36′ N. | 22°07′ E. | 1950 | 15-5-30 | $3^{00}$ | E. 300 | 1000 | 90 | 6 |
| 4075 | 38°29′ N. | 20°08′ E. | 2050 | 22-5-30 | $2^{00}$ | S. 200 | 50 | 90 | 2 |
| 4079 | 39°54′ N. | 14°49′ E. | 680—1160 | 24-5-30 | $20^{00}$—$22^{00}$ | S. 200 | 200 | 90 | 10 |
| » | » | » | » | » | » | S. 200 | 100 | » | 7 |
| » | » | » | 1825 | » | $22^{00}$ | S. 200 | 50 | » | 4 |
| 4089 | 40°29′ N. | 14°16′ E. | 1000 | 26-5-30 | $23^{00}$ | S. 200 | 250 | 90 | 9 |
| » | » | » | 1025 | 27-5-30 | $1^{00}$ | S. 200 | 50 | » | 1 |
| » | » | » | 1020 | » | $3^{00}$ | S. 200 | 50 | » | 3 |
| 4107 | 40°28′ N. | 14°15′ E. | 1040 | 27/28-5-30 | $22^{45}$—$0^{45}$ | S. 200 | 200 | 90 | 6 |
| » | » | » | 1040—950 | » | $22^{45}$—$0^{45}$—$2^{45}$ | S. 200 | 150 | » | 11 |
| » | » | » | » | » | » | S. 200 | 100 | » | 12 |
| 4118 | 40°35′ N. | 13°40′ E. | 1020 | 29-5-30 | $20^{00}$ | S. 200 | 150 | 90 | 4 |
| 4119 | 40°13′ N. | 12°06′ E. | 3350 | 30-5-30 | $23^{00}$ | S. 200 | 300 | 90 | 10 |
| » | » | » | 2400 | 31-5-30 | $1^{00}$ | S. 200 | 150 | » | 3 |
| » | » | » | 3375 | » | » | S. 200 | 100 | » | [illegible] |
| 4121 | 38°22′ N. | 13°04′ E. | 950 | 1-6-30 | $0^{50}$ | S. 200 | 250 | 120 | 2 |
| » | » | » | » | » | » | S. 200 | 100 | » | 12 |
| 4122 | 38°27′ N. | 10°20′ E. | 2000 | 1-6-30 | $20^{00}$ | S. 200 | 250 | 90 | 1 |
| » | » | » | » | » | » | S. 200 | 200 | » | 3 |
| 4124 | 37°24′ N. | 2°58′ E. | 2630 | 3-6-30 | $22^{40}$ | S. 200 | 250 | 90 | 8 |
| » | » | » | » | » | » | S. 200 | 200 | » | [illegible] |
| » | » | » | » | » | » | S. 200 | 150 | » | 5 |
| » | » | » | » | » | » | S. 200 | 100 | » | 5 |
| 4125 | 36°54′ N. | 3°03′ E. | 2640 | 5-6-30 | $2^{00}$ | S. 200 | 250 | 90 | 6 |
| » | » | » | » | » | » | S. 200 | 200 | » | [illegible] |
| » | » | » | » | » | » | S. 200 | 150 | » | 54 |
| » | » | » | » | » | » | S. 200 | 100 | » | 47 |

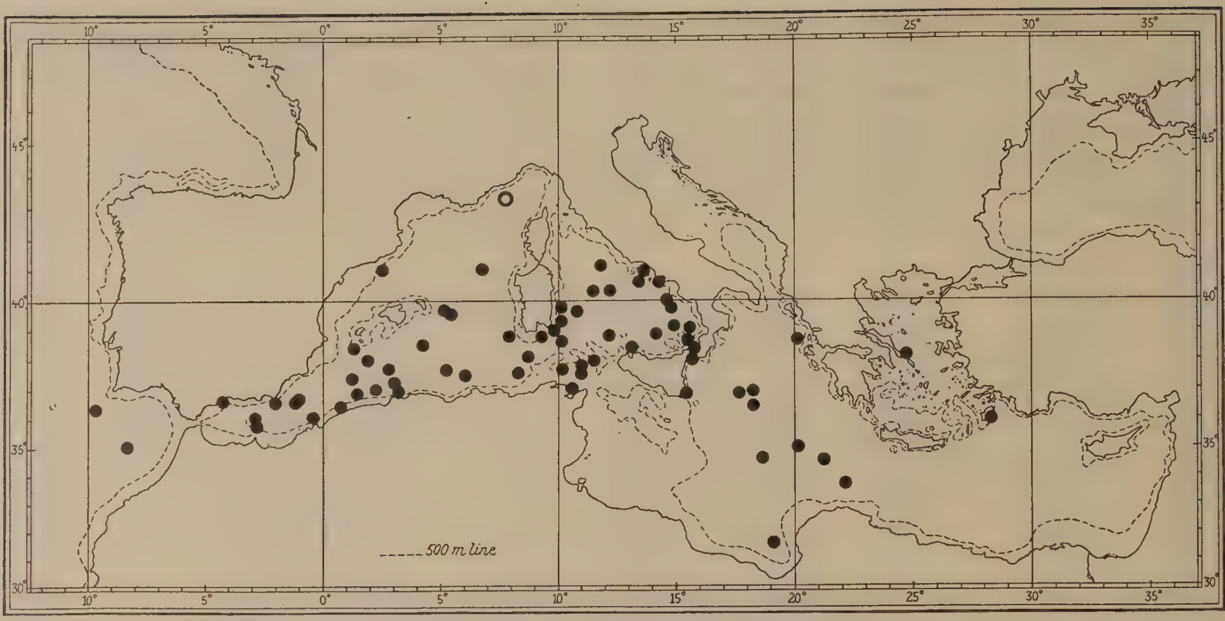

Chart 13. Occurrence of *Torrea candida* (delle Chiaje).
● new records. ○ previous record.

In the older literature the species is best known under the name of *Asterope candida*. Monro (1930), however, substantiates that the generic name *Asterope* Quatrefages 1870 is preoccupied and furthermore antedated by *Torrea* Quatrefages 1850.

The body is long, 15—25 cm., by only 2—3 mm.; the number of segments very great (abt. 235); the body gradually tapers posteriorly, is almost transparent with dark brown segment glands often so well developed that they unite pairwise to form transversal bands. The eyes are enormous and of reddish brown colour; the prostomium does not extend beyond the eyes. One little knot-like antenna between the eyes, 2 pairs of rather short antennæ. The proboscis with two long lateral cirriform processes and between them several small rounded papillæ. 3 pairs of tentacular cirri. The first two pairs of feet are rudimentary. In the female their dorsal cirri are transformed into large, globular seminal pouches (shown by Fauvel 1907, p. 8)). From the 3rd segment the feet are normally developed with large foliaceous ventral and dorsal cirri and a bundle of long compound, hirsute bristles. Last segment with two long pygidial styles.

The species, which is easily distinguished from all other Mediterranean Alciopids by its thread-like body with the dark transversal, equally distanced pigment-bands, is widespread in the Mediterranean and is one of the most common in the samples. A glance at the chart will show that it is especially abundant in the Tyrrhenian and Balearic Seas; the richest catches have also been made in these regions. It is an oceanic form widely distributed in the temporate areas of the

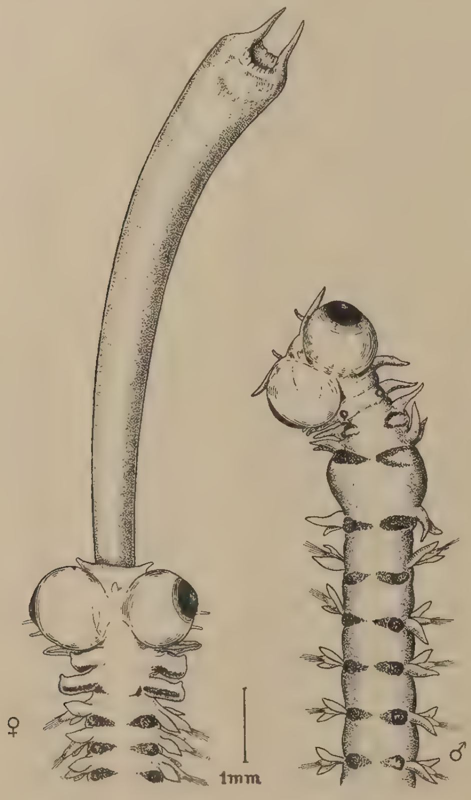

Fig. 17. *Torrea candida* (delle Chiaje).

Atlantic, living in the upper water-layers and thus easily able to cross the threshold at Gibraltar. In this connection it is worth mentioning, that in the warmest and most saline parts of the Mediterranean it is either absent or very scarce.

During the winter 1908—09 the "Thor" has taken the species at several stations between 18° Long. E. and 9° Long. W., i. e. throughout the greater part of the Mediterranean, but always very few per catch. The rich catches have always been taken in the summer months.

The species is known from southern part of the Atlantic and from the Indian Ocean.

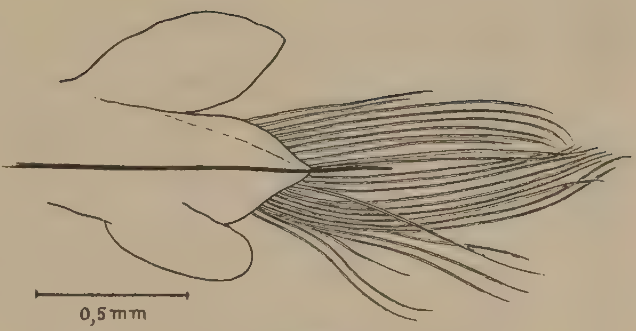

Fig. 18. *Torrea candida* (delle Chiaje). Parapodium from the middle part of the body.

## ALCIOPA CANTRAINII (delle Chiaje).

*Liocapa vitrea* Costa 1861, p. 167.
*Alciopa microcephala* Viguier 1886, p. 167.
*Alciopa Edwardsi* Hering 1892, p. 721.
*Alciopa cantrainii* Apstein 1900, p. 7.
*Alciopa cantrainii* Lo Bianco 1904, p. 50.
*Alciopa cantrainii* Fauvel 1916, p. 64.
*Alciopa cantrainii* Fauvel 1923, p. 203.

Material.

| Station Nr. | Lat. | Long. | Depth Metres | Date | Hour | Gear | Wire out Metres | Duration of haul in minutes | Number of specimens |
|---|---|---|---|---|---|---|---|---|---|
| "Thor" | | | | | | | | | |
| 10 | 37°21′ N. | 16°45′ E. | > 2100 | 15-12-08 | $5^{00}$ $6^{10}$ $8^{00}$ | Y. 200<br>C. 130 | 25, 65, 300 | 30—60 | 3, 2, 2 |
| 11 | 36°57′ N. | 18°16′ E. | > 3700 | 16-12-08 | $4^{00}$ $5^{25}$ | Y. 200 | 25—65 | 60 | 3, 1 |
| 22 | 38°50′ N. | 15°18′ E. | > 750 | 7-1-09 | $20^{45}$ | Y. 200 | 200 | 30 | 3 |
| 23 | 40°34′ N. | 13°24′ E. | > 1800 | 15-1-09 | $23^{50}$ | Y. 200 | 25 | 30 | 2 |
| 24 | 40°14′ N. | 12°23′ E. | > 3700 | 16-1-09 | $7^{50}$ $9^{00}$ | Y. 200 | 65—300 | 60—30 | 2, 2 |
| 26 | 40°40′ N. | 13°59′ E. | 560 | 19-1-09 | $0^{50}$ | Y. 200 | 150 | 180 | 1 |
| 28 | 40°53′ N. | 13°43′ E. | 600 | 19-1-09 | $21^{00}$ | Y. 200 | 200 | 30 | 1 |
| 29 | 40°47′ N. | 12°55′ E. | 1550 | 20-1-09 | $14^{15}$ | Y. 200 | 1650 | 60 | 1 |
| 31 | 41°44′ N. | 10°52′ E. | 1420 | 22-1-09 | $1^{20}$ | Y. 200 | 1400 | 60 | 2 |
| 35 | 43°36′ N. | 7°36′ E. | > 2000 | 29-1-09 | $6^{40}$ $7^{55}$ | Y. 200 | 100—200 | 60 | 2, 2 |
| 39 | 39°41′ N. | 10°02′ E. | 1750 | 1-2-09 | $6^{10}$ $7^{20}$ | Y. 200 | 300—65 | 60 | 2, 1 |
| 40 | 39°10′ N. | 9°40′ E. | 235 | 1-2-09 | $21^{30}$ | Y. 200 | 65 | 30 | 1 |
| 43 | 38°14′ N. | 8°42′ E. | > 2000 | 3-2-09 | $6^{15}$ | Y. 200 | 65 | 30 | 2 |
| 45 | 37°28′ N. | 8°18′ E. | > 2150 | 7-2-09 | $0^{15}$ | Y. 200 | 65 | 30 | 1 |
| 47 | 36°55′ N. | 3°12′ E. | > 2000 | 10-2-09 | $22^{20}$ | Y. 200 | 65 | 30 | 1 |
| 115 | 38°17′ N. | 4°11′ E. | 2800 | 29-6-10 | $1^{40}$ | Y. 200 | 25 | 15 | 1 |
| 116 | 39°27′ N. | 5°26′ E. | 2860 | 30-6-10 | $2^{30}$ | Y. 200 | 65 | 30 | 1 |
| 123 | 44°14′ N. | 8°55′ E. | ca. 700 | 3-7-10 | $0^{55}$ | Y. 200 | 65 | 30 | 1 |
| 129 | 40°05′ N. | 11°31′ E. | 3420 | 12-7-10 | $3^{00}$ $3^{40}$<br>$4^{20}$ $20^{00}$ | Y. 200 | 25, 300,<br>600, 1000 | 30, 30,<br>30, 60 | 1, 3, 2, 5 |
| 130 | 39°35′ N. | 11°20′ E. | > 3000 | 13-7-10 | $0^{50}$ | Y. 200 | 25 | 30 | 5 |
| 131 | 38°36′ N. | 11°00′ E. | 915 | 13-7-10 | $10^{35}$ | Y. 200 | 300 | 30 | 1 |
| 132 | 38°57′ N. | 9°47′ E. | 1227 | 14-7-10 | $3^{05}$ $3^{45}$ | Y. 200 | 25—300 | 30 | 4, 3 |
| 133 | 38°18′ N. | 9°59′ E. | 602 | 14-7-10 | $21^{20}$ $23^{00}$ | Y. 200 | 600—25 | 30 | 4, 2 |
| 138 | 37°37′ N. | 11°25′ E. | 788 | 19-7-10 | $21^{50}$ | Y. 200 | 25 | 30 | 10 |
| 143 | 35°18′ N. | 16°25′ E. | 1842 | 23-7-10 | $0^{30}$ $1^{20}$ | Y. 200 | 25—300 | 30 | 3, 1 |
| 144 | 34°31′ N. | 18°40′ E. | 3340 | 24-7-10 | $2^{00}$ $2^{45}$ $3^{45}$ | Y. 200 | 25, 300, 2000 | 30, 60 | 1, 10, 2 |
| 145 | 32°38′ N. | 19°02′ E. | 3340 | 25-7-10 | $3^{30}$ | Y. 200 | 25 | 30 | 3 |
| 147 | 31°35′ N. | 19°02′ E. | 960—993 | 25/26-7-10 | $20^{00}$ $0^{20}$ | Y. 200 | 25, 300 | 30 | 2, 5 |
| 152 | 33°11′ N. | 21°44′ E. | > 2200 | 27-7-10 | $23^{35}$ | Y. 200 | 300 | 30 | 2 |
| 156 | 32°16′ N. | 26°03′ E. | ca. 3200 | 30-7-10 | $0^{40}$ $3^{00}$ | Y. 200 | 25, 600 | 30 | 1, 1 |
| 160 | 35°59′ N. | 28°14′ E. | 2980 | 1-8-10 | $14^{20}$ | Y. 200 | 25 | 30 | 1 |
| 163 | 37°52′ N. | 26°22′ E. | 1170 | 3-8-10 | $1^{05}$ | Y. 200 | 200 | 15 | 1 |
| 186 | 37°57′ N. | 19°51′ E. | > 3000 | 17-8-10 | $20^{15}$ $23^{30}$ $24^{00}$ | Y. 200 | 10, 65, 300 | 15 | 1, 2, 1 |
| 187 | 37°54′ N. | 18°02′ E. | > 2500 | 18-8-10 | $16^{45}$ $18^{40}$ | N. 50 Y. 200 | 25, 100, 1000 | 30 | 4, 15, 3 |

| Station Nr. | Lat. | Long. | Depth Metres | Date | Hour | Gear | Wire out Metres | Duration of haul in minutes | Number of specimens |
|---|---|---|---|---|---|---|---|---|---|
| **"Thor"** | | | | | | | | | |
| 189 | 37°44′ N. | 15°58′ E. | < 2000 | 19-8-10 | $8^{55}$ | Y. 200 | 300 | 15 | 3 |
| 190 | 37°51′ N. | 15°19′ E. | 360 | 19-8-10 | $20^{15}$ | Y. 200 | 25 | 15 | 2 |
| 192 | 38°07′ N. | 15°35′ E. | 650 | 20-8-10 | $21^{40}$ $22^{10}$ $22^{15}$ | Y. 200 | 25, 300, 600 | 15—30 | 1, 4, 1 |
| 193 | 38°15′ N. | 15°39′ E. | > 100 | 21-8-10 | $0^{50}$ | Y. 200 | 10 | 30 | 3 |
| 194 | 38°33′ N. | 15°29′ E. | 1140 | 21-8-10 | $4^{30}$ $5^{00}$ $6^{00}$ | Y. 200 | 10, 25, 1200 | 15, 30 | 16, 18, 2 |
| 195 | 39°02′ N. | 14°55′ E. | ca. 3160 | 21-8-10 | $18^{10}$ $18^{50}$ | Y. 200 | 65, 300 | 15, 30 | 3, 4 |
| 196 | 39°59′ N. | 14°31′ E. | > 600 | 22-8-10 | $2^{40}$ | Y. 200 | 25 | 30 | 21 |
| 197 | 40°34′ N. | 13°36′ E. | > 1000 | 24-8-10 | $19^{00}$ $19^{45}$ | Y. 200 | 25, 300 | 15, 30 | 10, 2 |
| 199 | 39°32′ N. | 10°49′ E. | ca. 2700 | 25-8-10 | $21^{00}$ $21^{25}$ $22^{10}$ | Y. 200 | 300, 25, 1000 | 30, 20, 15 | 2, 3, 5 |
| 200 | 39°18′ N. | 10°11′ E. | > 2000 | 26-8-10 | $3^{45}$ | Y. 200 | 25 | 30 | 2 |
| 204 | 38°52′ N. | 7°43′ E. | > 1000 | 27-8-10 | $4^{00}$ $4^{30}$ | Y. 200 | 25, 65 | 15 | 5 |
| 205 | 39°16′ N. | 5°52′ E. | ca. 2860 | 27-8-10 | $19^{35}$ | Y. 200 | 25 | 15 | 2 |
| 206 | 39°32′ N. | 5°15′ E. | ca. 2860 | 28-8-10 | $0^{30}$ | Y. 200 | 25 | 15 | 3 |
| 208 | 40°18′ N. | 3°20′ E. | > 1600 | 29-8-10 | $1^{40}$ | Y. 200 | 25 | 15 | 2 |
| 279 | 38°11.5′ N. | 15°36.5′ E. | 350 | 23-2-11 | $19^{00}$ | S. 100 | 30 | 120 | 2 |
| 283 | 38°12′ N. | 15°37.5′ E. | 200 | 12-3-11 | $21^{45}$ | S. 100 | 40 | 180 | 7 |
| **"Dana"** | | | | | | | | | |
| 1108 | 35°11′ N. | 8°28′ W. | ? | 14-9-21 | $20^{15}$ | Y. 200<br>S. 200 | 50, 100, 300 | 120 | 2, 4, 3 |
| 1117 | 35°59′ N. | 5°30′ W. | 514 | 21-9-21 | $18^{15}$ | S. 200 | 100 | 120 | 4 |
| 1120 | 36°24′ N. | 1°00′ W. | ? | 24-9-21 | $4^{40}$ | S. 200 | 100 | 120 | 3 |
| 1122 | 37°12′ N. | 1°08′ E. | ? | 25-9-21 | $21^{30}$ | S. 200 | 100, 150, 200 | 120 | 3, 2, 6 |
| 1123 | 37°48′ N. | 2°44′ E. | ? | 26-9-21 | $18^{40}$ | S. 200 | 50 | 120 | 4 |
| 1124 | 37°15′ N. | 2°55′ E. | ? | 27-9-21 | $3^{20}$ | S. 200 | 100, 150, 200, 250 | 120 | 1, 1, 2, 3 |
| 1130 | 36°38′ N. | 2°00′ W. | ? | 2-10-21 | $18^{30}$ | S. 200 | 200 | 60 | 2 |
| 4027 | 35°50′ N. | 2°55′ W. | 930 | 10-4-30 | $22^{40}$ | S. 200 | 100 | 60 | 3 |
| 4030 | 36°17′ N. | 1°55′ W. | 1900 | 11-4-30 | $21^{30}$ | S. 200 | 50 | 60 | 1 |
| 4031 | 36°42′ N. | 1°16.5′ E. | 2250 | 13-4-30 | $3^{30}$ | S. 200 | 200 | 90 | 4 |
| 4034 | 37°12′ N. | 3°08′ E. | 2790 | 20-4-30 | $19^{10}$ | S. 200 | 100, 150, 200 | 90 | 4, 1, 2 |
| 4035 | 37°37′ N. | 5°06′ E. | 2700 | 21-4-30 | $23^{55}$ | S. 200 | 100, 200, 250 | 90 | 2, 3, 1 |
| 4036 | 38°28′ N. | 7°59′ E. | 2640 | 22-4-30 | $22^{00}$ | S. 200 | 150—200 | 90 | 1. 2 |
| 4040 | 38°21′ N. | 9°24′ E. | 1830—1950—1975 | 23/24-4-30 | $20^{15}$ $0^{30}$ $2^{30}$ | S. 200 | 50, 100, 200, 250, 300 | 90 | 1, 3, 2, 4, 5 |
| 4043 | 37°30.5′ N. | 11°00′ E. | 310—340 | 24-4-30 | $22^{30}$ | S. 200 | 200, 250 | 90 | 2, 3 |
| 4044 | 37°24.5′ N. | 11°01′ E. | 255 | 25-4-30 | $2^{45}$ | S. 200 | 250 | 90 | 4 |
| 4045 | 37°04′ N. | 10°35′ E. | 118 | 25-4-30 | $9^{45}$ | S. 200 | 50 | 60 | 6 |
| 4047 | 37°05′ N. | 10°35′ E. | 95 | 1-5-30 | $20^{00}$ | S. 200 | 25 | 60 | 4 |
| 4048 | 37°42′ N. | 11°22′ E. | 625—550—610—600 | 2-5-30 | $3^{15}$ | S. 200 | 150, 250, 350, 450 | 120 | 1, 2, 4, 3 |
| 4050 | 38°48′ N. | 12°06′ E. | 2290—2160—2050 | 2/3-5-30 | $19^{30}$ $23^{45}$ $2^{00}$ | S. 200 | 50, 100, 150, 200, 250, 300 | 90 | 2, 1, 4, 3, 4, 3 |
| 4051 | 38°47′ N. | 15°04′ E. | 2490—1860 | 3-5-30 | $21^{30}$ $23^{40}$ | S. 200 | 50, 150, 200, 250, 300 | 90 | 1, 4, 2, 3, 4 |
| 4052 | 39°04′ N. | 15°29′ E. | 2010—1825 | 5-5-30 | $3^{10}$ | S. 200 | 100, 150, 200, 250 | 120 | 1, 4, 2, 3 |
| 4054 | 38°00′ N. | 15°33′ E. | 1125—1070 | 5-5-30 | $19^{30}$ $23^{15}$ | S. 200 | 50, 100, 150, 200, 250 | 90 | 1, 4, 1, 3, 2 |
| 4055 | 38°12.5′ N. | 15°36′ E. | 175—125 | 6-5-30 | $5^{30}$ | S. 200 | 50, 100, 125 | 90 | 4, 6, 2 |
| 4056 | 38°28′ N. | 15°38′ E. | 1100 | 7-5-30 | $3^{20}$ | S. 200 | 50, 100, 150, 200 | 90 | 1, 1, 1, 2 |
| 4058 | 37°19.5′ N. | 15°22′ E. | 1510—1220—1340 | 7-5-30 | $19^{30}$ $21^{30}$ $23^{30}$ | S. 200 | 25, 75, 100, 125, 150, 175, 200, 225 | 90 | 1, 1, 2, 1, 3, 1, 1, 2 |
| 4060 | 36°47′ N. | 15°21′ E. | 1220—2700 | 10/11-5-30 | $23^{30}$ $3^{20}$ | S. 200 | 50, 100, 150, 250, 300, 300 | 90 | 1, 1, 2, 1, 2, 3 |
| 4061 | 37°47′ N. | 15°22′ E. | 1475—1150 | 12-5-30 | $3^{30}$ | S. 200 | 100, 150, 200, 250 | | 3, 4, 2, 2 |
| 4062 | 36°40′ N. | 17°40′ E. | 3250 | 12-5-30 | $20^{20}$ | S. 200 | 100, 300, 600 | 90 | 2, 3, 1 |
| 4063 | 36°18′ N. | 18°20′ E. | 3850 | 13-5-30 | $3^{20}$ | S. 200 | 300 | 90 | 4 |
| 4065 | 35°22′ N. | 19°28′ E. | 3075 | 13-5-30 | $20^{20}$ | S. 200 | 200, 300, 600 | 90 | 4,3, 2 |
| 4075 | 38°29′ N. | 20°08′ E. | 2050 | 22-5-30 | $2^{30}$ | S. 150 | 950 | 90 | 4 |
| 4076 | 38°28′ N. | 18°21′ E. | 2255 | 23-5-30 | $2^{10}$ | S. 200 | 300 | 90 | 5 |
| » | » | » | » | » | » | S. 200 | 100 | » | 4 |
| 4077 | 37°32′ N. | 15°51′ E. | 1790 | 23-5-30 | $20^{30}$ | S. 200 | 250 | 90 | 4 |
| 4078 | 37°50′ N. | 15°32′ E. | 1550 | 24-5-30 | $2^{40}$ | S. 200 | 200 | 90 | 4 |
| » | » | » | » | » | » | S. 200 | 150 | » | 5 |
| 4079 | 39°54′ N. | 14°49′ E. | 680—1160 | 24-5-30 | $20^{30}$ $22^{30}$ | S. 200 | 150 | 90 | 5 |
| » | » | » | » | » | » | S. 200 | 100 | » | 6 |
| 4089 | 40°29′ N. | 14°16′ E. | 1000—1025 | 26/27-5-30 | $23^{20}$ $1^{20}$ | S. 200 | 150 | 90 | 2 |
| » | » | » | » | » | » | S. 200 | 100 | » | 2 |
| » | » | » | 1025 | 27-5-30 | $1^{20}$ | S. 200 | 50 | » | 3 |
| » | » | » | 1050 | » | $3^{30}$ | S. 200 | 100 | » | 3, 3 |

| Station Nr. "Dana" | Lat. | Long. | Depth Metres | Date | Hour | Gear | Wire out Metres | Duration of haul in minutes | Number of specimens |
|---|---|---|---|---|---|---|---|---|---|
| 4118 | 40°35′ N. | 13°40′ E. | 1020 | 29-5-30 | $20^{30}$ | S. 200 | 150 | 90 | 3 |
| » | » | » | 1440 | » | $22^{40}$ | S. 200 | 250 | » | 10 |
| 4119 | 40°13′ N. | 12°06′ E. | 3200 | 30-5-30 | $17^{10}$ | P. 100 | 800 | 45 | 3 |
| » | » | » | » | » | » | P. 100 | 600 | » | 2 |
| » | » | » | 2700 | » | $19^{45}$ | S. 150 | 4000 | 120 | 1 |
| » | » | » | 3350 | » | $23^{30}$ | S. 200 | 50—600 | 90 | 2, 6 |
| » | » | » | » | » | » | S. 200 | 100 | » | 8 |
| » | » | » | » | » | » | S. 200 | 50 | » | 7 |
| » | » | » | 2400 | 31-5-30 | $1^{50}$ | S. 200 | 250 | » | 6 |
| 4120 | 38°34′ N. | 13°12′ E. | 1825 | 31-5-30 | $22^{20}$ | S. 200 | 100 | 90 | 6 |
| 4121 | 38°22′ N. | 13°04′ E. | 950 | 1-6-30 | $0^{50}$ | S. 200 | 250 | 120 | 11 |
| » | » | » | » | » | » | S. 200 | 200 | » | 8 |
| 4122 | 38°27′ N. | 10°20′ E. | 2000 | 1-6-30 | $20^{00}$ | S. 200 | 200 | 90 | 10 |
| » | » | » | » | » | » | S. 200 | 150 | » | 3 |
| » | » | » | » | » | » | S. 200 | 100 | » | 2 |
| 4123 | 38°20′ N. | 10°16′ E. | 1200 | 1-6-30 | $22^{30}$ | S. 200 | 250 | 90 | 2 |
| » | » | » | » | » | » | S. 200 | 200 | » | 5 |
| 4124 | 37°24′ N. | 2°58′ E. | 2630 | 3-6-30 | $22^{40}$ | S. 200 | 250 | 90 | 1 |
| » | » | » | » | » | » | S. 200 | 200 | » | 3 |
| » | » | » | » | » | » | S. 200 | 150 | » | 1 |
| 4125 | 36°54′ N. | 3°03′ E. | 2640 | 5-6-30 | $2^{20}$ | S. 200 | 250 | 90 | 4 |
| » | » | » | » | » | » | S. 200 | 200 | » | 4 |
| » | » | » | » | » | » | S. 200 | 150 | » | 3 |
| 4136 | 36°06′ N. | 0°16′ W. | 1460—2280 | 6-6-30 | $21^{30}$ $23^{30}$ | S. 200 | 150 | 90 | 1 |

The body is long (may exceed 100 mm.) by 2—5 mm., transparent and yellowish-white with dark, laterally placed, cushion-like, brown segmental glands. Prostomium does not extend beyond the enormous, reddish eyes. The proboscis is short, swollen and bell-shaped with two small digitiform, lateral processes between which a few small, indistinctly trilobated papillæ are found. 5 small antennæ, the unpaired one a rudimentary knot. 3 pairs of tentacular cirri; the first pair much longer than the following. In the first three rudimentary pairs of feet the dorsal and ventral cirri are present, but the pedal lobe is quite small without any bristles, only with a short aciculum. In the female the dorsal cirri of the second pair of

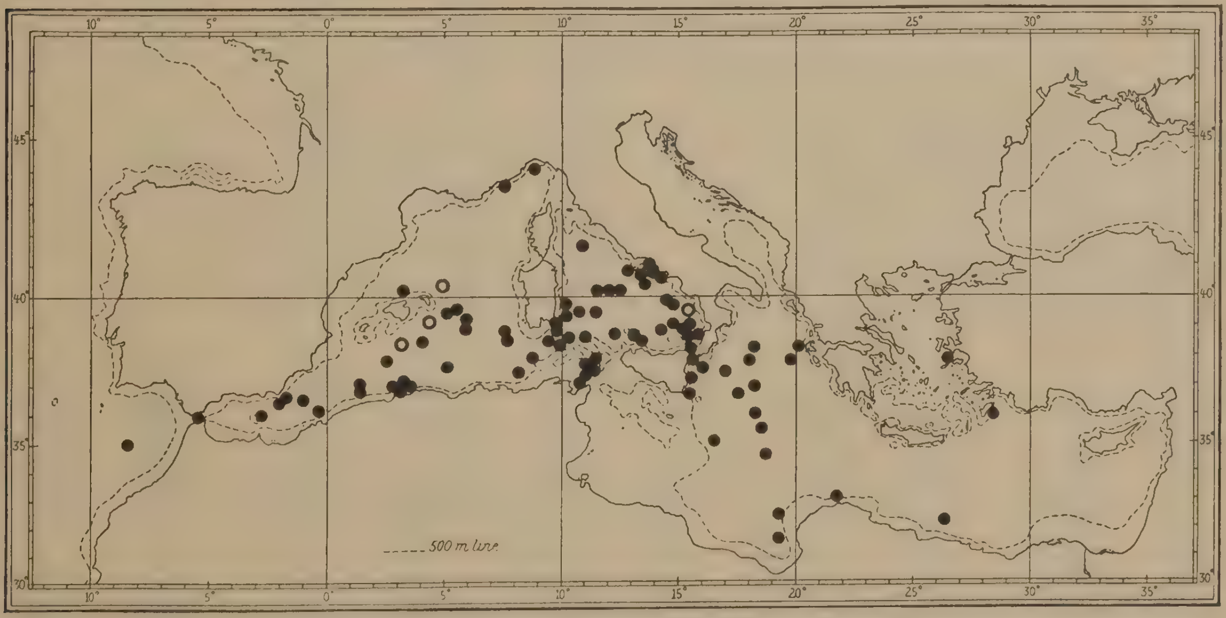

Chart 14. Occurrence of *Alciopa Cantrainii* (delle Chiaje).

● new records. ○ previous records.

these feet are transformed into globular seminal pouches, which when filled with sperma may attain a voluminous size. The following feet—from the 4th chaetiger—are normal with foliaceous, dorsal and ventral cirri and a conical pedal lobe with a long aciculum projecting among the bristles. All the bristles are equally long, delicate, capillary and simple. From the 4th chaetiger segmental glands are present, often developed into great, vaulted, darkbrown, circular cushions.

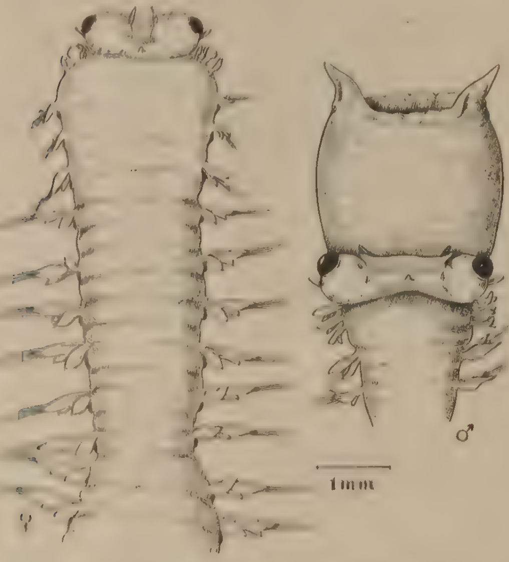

Fig. 10. *Alciopa Cantrainii* (delle Chiaje).

The species, which of course was previously well known from the Mediterranean, is one of the most common Alciopids in this Sea. It may without closer examination be distinguished from other Alciopids by its peculiar puffed-up aspect; it looks as if it were distended with air especially in the foremost part of the body. The chart shows a distribution almost exactly like the distribution of *Torrea candida*; like this it is especially abundant in the Tyrrhenian and the eastern part of the Balearic Sea. Almost all the older finds were also made inside these regions. Lo Bianco (1904) states that it is common in the surface-water in winter and spring in the Gulf of Naples.

The list given above shows that the species is a true oceanic form, occurring in the upper water-layers, often close to the surface proper. It is problematic how much stress should be laid on the few bathypelagic hauls which numerically do not play any rôle amongst the catches; it should be borne in mind that the apparatus—either young fish trawl or stramin net—are open, and the polychaetes may be taken on hauling in. In none of these catches is the number of specimens considerable.

*Alciopa cantrainii* is widely spread in the tropic and temperate zones of the Atlantic and Pacific.

## VANADIS FORMOSA Claparède.

*Vanadis formosa* Claparède 1870, p. 116.
*Vanadis pelagica* Greeff 1876, p. 67.
*Vanadis longicauda* Apstein 1891, p. 5.
*Vanadis latocirrata* Apstein 1891, p. 7.
*Alciopa Krohnii* Hering 1892, p. 738.
*Vanadis formosa* Apstein 1900, p. 8.
*Vanadis formosa* Lo Bianco 1904, p. 50.
*Vanadis formosa* Southern 1911, p. 2.
*Vanadis formosa* Fauvel 1916, p. 65.
*Vanadis formosa* Fauvel 1923, p. 205.
*Vanadis formosa* Monro 1930, p. 81.
*Vanadis formosa* Fauvel 1932, p. 16.
*Vanadis formosa* Monro 1936, p. 116.

Material.

| Station Nr. | Lat. | Long. | Depth Metres | Date | Hour | Gear | Wire out Metres | Duration of haul in minutes | Number of specimens |
|---|---|---|---|---|---|---|---|---|---|
| "Thor" | | | | | | | | | |
| 10 | 37°21′ N. | 16°45′ E. | > 2100 | 15-12-08 | $5^{00}$ $6^{10}$<br>$8^{00}$ $15^{45}$ | Y. 200<br>C. 130 | 25, 65, 300, 600 | 60—30 | 5, 2, 1, 1 |
| 11 | 36°57′ N. | 18°16′ E. | > 3700 | 16-12-08 | $4^{00}$ $5^{25}$ | Y. 200 | 25, 65 | 60 | 5, 3 |
| 12 | 39°34′ N. | 17°17′ E. | 1060 | 19-12-08 | $13^{00}$ | Y. 200 | 65 | 30 | 1 |
| 24 | 40°14′ N. | 12°23′ E. | > 3700 | 16-1-09 | $21^{10}$ | Y. 200 | 300 | 30 | 3 |
| 25 | 40°34′ N. | 13°24′ E. | > 1800 | 17-1-09 | $16^{40}$ $17^{40}$ | Y. 200 | 65, 300 | 30, 60 | 1, 2 |
| 26 | 40°40′ N. | 13°59′ E. | 560 | 18/19-1-09 | $2^{15}$ $0^{50}$ | Y. 200 | 150, 300 | 180, 60 | 2, 1 |
| 28 | 40°53′ N. | 13°43′ E. | 600 | 19-1-09 | $18^{40}$ $22^{00}$ | Y. 200 | 100, 400 | 30—60 | 1, 1 |
| 30 | 41°15′ N. | 11°55′ E. | > 1800 | 21-1-09 | $5^{30}$ | Y. 200 | 65 | 60 | 3 |
| 31 | 41°44′ N. | 10°52′ E. | 1420 | 22-1-09 | $3^{50}$ $4^{30}$ | Y. 200 | 65, 200 | 30 | 2, 5 |

| Station Nr. | Lat. | Long. | Depth Metres | Date | Hour | Gear | Wire out Metres | Duration of haul in minutes | Number of specimens |
|---|---|---|---|---|---|---|---|---|---|
| **"Thor"** | | | | | | | | | |
| 34 | 43°27′ N. | 8°16′ E. | > 2000 | 23-1-09 | $6^{35}$ | Y. 200 | 200 | 30 | 1 |
| 35 | 43°36′ N. | 7°36′ E. | > 2000 | 29-1-09 | $6^{40}$ $7^{55}$ | Y. 200 | 100, 200 | 60 | 4, 2 |
| 36 | 42°49′ N. | 6°54′ E. | > 2000 | 30-1-09 | $6^{50}$ | Y. 200 | 300 | 60 | 1 |
| 38 | 40°45′ N. | 9°50′ E. | 105 | 31-1-09 | $18^{30}$ | Y. 200 | 65 | 30 | 1 |
| 39 | 39°41′ N. | 10°02′ E. | 1750 | 1-2-09 | $6^{10}$ $7^{20}$ | Y. 200 | 65, 300 | 60 | 2, 1 |
| 43 | 38°14′ N. | 8°42′ E. | > 2000 | 3-2-09 | $6^{15}$ | Y. 200 | 65 | 30 | 10 |
| 45 | 37°28′ N. | 8°18′ E. | > 2150 | 6-2-09 | $23^{25}$ | Y. 200 | 300 | 30 | 2 |
| 46 | 37°17′ N. | 6°00′ E. | > 1930 | 7-2-09 | $19^{30}$ $20^{20}$ | Y. 200 | 65, 300 | 30 | 1, 3 |
| 47 | 36°55′ N. | 3°12′ E. | > 2000 | 10-2-09 | $23^{05}$ | Y. 200 | 300 | 30 | 2 |
| 55 | 36°46′ N. | 2°18′ W. | 75 | 19-2-09 | $7^{40}$ | Y. 200 | 65 | 60 | 2 |
| 115 | 38°17′ N. | 4°11′ E. | 2800 | 28/29-6-10 | $23^{20}$ $1^{20}$ | Y. 200 | 65, 300 | 15, 30 | 3, 1 |
| 116 | 39°27′ N. | 5°26′ E. | 2860 | 30-6-10 | $1^{40}$ $2^{30}$ | Y. 200 | 65, 300 | 30 | 1, 2 |
| 118 | 41°00′ N. | 6°43′ E. | > 2700 | 30-6-10 | $22^{55}$ $23^{35}$ | Y. 200 | 65, 300 | 30 | 2, 1 |
| 123 | 44°14′ N. | 8°55′ E. | ca. 700 | 3-7-10 | $0^{55}$ | Y. 200 | 65 | 30 | 6 |
| 129 | 40°05′ N. | 11°31′ E. | 3420 | 12-7-10 | $4^{20}$ $20^{00}$ | Y. 200 | 600, 1000 | 60, 30 | 1, 15 |
| 131 | 38°36′ N. | 11°00′ E. | 915 | 13-7-10 | $10^{35}$ $10^{40}$ | Y. 200 | 300, 1000 | 30—60 | 2, 1 |
| 132 | 38°57′ N. | 9°47′ E. | 1227 | 14-7-10 | $3^{00}$ $3^{45}$ $4^{50}$ | Y. 200 | 25, 300, 600 | 30 | 3, 2, 10 |
| 133 | 38°18′ N. | 9°59′ E. | 602 | 14-7-10 | $22^{15}$ $23^{00}$ | Y. 200 | 25, 300 | 30 | 1, 9 |
| 134 | 37°37′ N. | 10°17′ E. | 400 | 15-7-10 | $5^{40}$ | Y. 200 | 300 | 30 | 1 |
| 137 | 37°17′ N. | 10°56′ E. | 195 | 19-7-10 | $9^{05}$ | Y. 200 | 250 | 30 | 3 |
| 138 | 37°37′ N. | 11°25′ E. | 788 | 19-7-10 | $21^{10}$ | Y. 200 | 300 | 60 | 5 |
| 143 | 35°18′ N. | 16°25′ E. | 1842 | 23-7-10 | $1^{20}$ | Y. 200 | 25 | 30 | 3 |
| 144 | 34°31′ N. | 18°40′ E. | 3340 | 24-7-10 | $2^{00}$ | Y. 200 | 25 | 30 | 4 |
| 147 | 31°35′ N. | 19°02′ E. | 993 | 26-7-10 | $0^{20}$ $1^{10}$ | Y. 200 | 300, 1000 | 30, 60 | 1, 1 |
| 152 | 33°11′ N. | 21°44′ E. | > 2200 | 27/28-7-10 | $23^{35}$ $0^{30}$ | Y. 200 | 300, 1000 | 30, 60 | 5, 1 |
| 154 | 32°10′ N. | 24°46′ E. | 365 | 29-7-10 | $4^{30}$ | Y. 200 | 300 | 30 | 3 |
| 156 | 32°16′ N. | 26°03′ E. | ca. 3200 | 30-7-10 | $0^{40}$ $2^{15}$ $3^{50}$ | Y. 200 | 25, 300, 1000 | 30, 60 | 1, 3, 4 |
| 158 | 34°23′ N. | 27°57′ E. | > 2000 | 31-7-10 | $7^{30}$ | Y. 200 | 300 | 30 | 3 |
| 160 | 35°59′ N. | 28°14′ E. | 2980—> 1000 | 1-8-10 | $2^{45}$ $3^{35}$<br>$15^{30}$ | Y. 200<br>C. 200 | 300, 1000, 4000 | 60, 30 | 1, 4, 1 |
| 161 | 36°12′ N. | 27°16′ E. | > 1000 | 2-8-10 | $3^{00}$ | Y. 200 | 25 | 30 | 3 |
| 163 | 37°52′ N. | 26°22′ E. | 1170 | 3-8-10 | $1^{05}$ | Y. 200 | 200 | 15 | 2 |
| 179 | 40°02′ N. | 25°55′ E. | 85 | 13-8-10 | $2^{15}$ | Y. 200 | 65 | 30 | 1 |
| 181 | 38°49′ N. | 25°09′ E. | 225 | 13-8-10 | $13^{25}$ $14^{55}$ | Y. 200<br>Y. | 65, 300 | 15, 20 | 1, 2 |
| 182 | 38°13′ N. | 24°48′ E. | 500 | 14-8-10 | $23^{40}$ | Y. 200 | 600 | 30 | 1 |
| 183 | 37°52′ N. | 23°09′ E. | 233 | 16-8-10 | $17^{10}$ | Y. 200 | 65 | 15 | 1 |
| 184 | 38°10′ N. | 22°33′ E. | 842 | 17-8-10 | $2^{45}$ | Y. 200 | 1000 | 30 | 1 |
| 186 | 37°57′ N. | 19°51′ E. | > 3000 | 17/18-8-10 | $23^{30}$ $0^{45}$ | Y. 200 | 10, 1200 | 15, 30 | 1 |
| 187 | 37°54′ N. | 18°02′ E. | > 2500 | 18-8-10 | $12^{55}$ $18^{40}$ | Y. 200 | 300, 1000 | 15, 30 | 3, 1 |
| 189 | 37°44′ N. | 15°58′ E. | < 2000 | 19-8-10 | $8^{55}$ | Y. 200 | 300 | 15 | 3 |
| 192 | 38°07′ N. | 15°35′ E. | 652 | 20-8-10 | $22^{50}$ | Y. 200 | 600 | 30 | 1 |
| 193 | 38°15′ N. | 15°39′ E. | > 100 | 21-8-10 | $0^{50}$ | Y. 200 | 10 | 30 | 1 |
| 194 | 38°33′ N. | 15°29′ E. | 1140 | 21-8-10 | $5^{00}$ $6^{00}$ | Y. 200 | 25 –1200 | 15, 30 | 6, 1 |
| 195 | 39°02′ N. | 14°55′ E. | ca. 3160 | 21-8-10 | $18^{10}$ $18^{50}$ | Y. 200 | 65, 300 | 15, 30 | 3, 3 |
| 196 | 39°59′ N. | 14°31′ E. | > 660 | 22-8-10 | $2^{40}$ | Y. 200 | 25 | 30 | 3 |
| 197 | 40°34′ N. | 13°36′ E. | > 1000 | 24-8-10 | $19^{00}$ | Y. 200 | 300 | 30 | 4 |
| 199 | 39°32′ N. | 10°49′ E. | ca. 2700 | 25-8-10 | $21^{00}$ $21^{25}$ $21^{30}$ | Y. 200 | 25, 300, 1000 | 15, 20, 30 | 3, 2, 4, 3 |
| 200 | 39°18′ N. | 10°11′ E. | > 2000 | 26-8-10 | $3^{45}$ | Y. 200 | 25 | 30 | 3 |
| 202 | 38°59′ N. | 9°25′ E. | 760 | 26-8-10 | $17^{05}$ | Y. 200 | 300 | 15 | 2 |
| 204 | 38°52′ N. | 7°43′ E. | > 1000 | 27-8-10 | $4^{00}$ $4^{30}$ $5^{00}$ $5^{45}$ | Y. 200 | 25—65, 300, 1000 | 15, 30 | 1, 5, 3, 2 |
| 205 | 39°16′ N. | 5°52′ E. | ca. 2860 | 27-8-10 | $19^{35}$ | Y. 200 | 25 | 15 | 4 |
| 206 | 39°32′ N. | 5°15′ E. | ca. 2860 | 28-8-10 | $0^{30}$ | Y. 200 | 25 | 15 | 4 |
| 208 | 40°18′ N. | 3°20′ E. | > 1600 | 29-8-10 | $1^{40}$ | Y. 200 | 25 | 15 | 1 |
| 232 | 36°28′ N. | 9°06′ W. | ca. 3500 | 9-9-10 | $20^{50}$ | Y. 200 | 25 | 30 | 5 |
| 275 | 39°05′ N. | 14°50′ E. | > 1000 | 3-4-11 | $20^{30}$ | S. 200 | 94 | 30 | 1 |
| 276 | 36°30′ N. | 19°20′ E. | > 3000 | 4-4-11 | $23^{20}$ | S. 200 | 132 | 35 | 28 |
| 277 | 33°20′ N. | 27°30′ E. | > 3000 | 6-4-11 | $23^{00}$ | S. 200 | 132 | 35 | 2 |
| 297 | 33°10′ N. | 25°03′ E. | > 2000 | 25-6-11 | $23^{30}$ | S. 200 | 28 | 30 | 1 |
| 298 | 34°20′ N. | 21°10′ E. | > 2000 | 26-6-11 | $23^{30}$ | S. 200 | 38 | 30 | 1 |
| 339 | 40°30′ N. | 3°10′ E. | > 2000 | 20-8-11 | $3^{00}$ | S. 200 | 28 | 30 | 1 |
| 340 | 35°50′ N. | 21°30′ E. | > 2000 | 26-8-11 | $21^{00}$ | S. 200 | 28 | 30 | 2 |
| **"Dana"** | | | | | | | | | |
| 1108 | 35°11′ N. | 8°28′ W. | ? | 14-9-21 | $20^{15}$ | S. 200 | 50, 100 | 120 | 7, 6 |
| 1117 | 35°59′ N. | 5°30′ W. | 514 | 22-9-21 | $0^{15}$ | S. 200 | 25 | 30 | 3 |
| 1120 | 36°24′ N. | 1°00′ W. | ? | 24-9-21 | $4^{40}$ | S. 200 | 150 | 120 | 4 |
| 1122 | 37°12′ N. | 1°08′ E. | ? | 25/26-9-21 | $21^{30}$ $0^{10}$ | S. 200 | 100, 150, 200 | 120 | 3, 4, 2 |

| Station Nr. | Lat. | Long. | Depth Metres | Date | Hour | Gear | Wire out Metres | Duration of haul in minutes | Number of specimens |
|---|---|---|---|---|---|---|---|---|---|
| "Dana" | | | | | | | | | |
| 1123 | 37°48' N. | 2°44' E. | ? | 26-9-21 | 21$^{40}$ | S. 200 | 200 | 90 | 6 |
| 1124 | 37°15' N. | 2°[illegible]' E. | ? | 27-9-21 | 3$^{20}$ | S. 200 | 100, 150, 200, 250 | 120 | 1, 1, 2, 1 |
| 1128 | 36°46' N. | 0°16' E. | ? | 1-10-21 | 21$^{50}$ | S. 200 | 400 | 60 | 2 |
| 1130 | 36°38' N. | 2°00' W. | ? | 2-10-21 | 18$^{30}$ | S. 200 | 200 | 60 | 3 |
| 4025 | 35°58,8' N. | 5°25' W. | 840 | 10-4-30 | 2$^{30}$ | S. 200 | 600 | 90 | 1 |
| 4034 | 37°12' N. | 3°08' E. | 2790 | 20-4-30 | 19$^{10}$ | S. 200 | 200, 250 | 90 | 1, 1 |
| 4035 | 37°37' N. | 6°06' E. | 2710 | 21-4-30 | 19$^{00}$ | S. 200 | 100, 150 | 90 | 1, 2 |
| 4036 | 38°28' N. | 7°59' E. | 2640 | 22-4-30 | 20$^{00}$ | S. 200 | 50, 100 | 90 | 1, 4 |
| 4040 | 38°21' N. | 9°24' E. | 1830 | 23-4-30 | 20$^{15}$ | S. 200 | 50, 100, 150 | 90 | 1, 2, 1 |
| 4043 | 37°30,5' N. | 11°00' E. | 340 | 24-4-30 | 22$^{30}$ | S. 200 | 200 | 90 | 3 |
| 4045 | 37°04' N. | 10°35' E. | 118 | 25-4-30 | 9$^{45}$ | S. 200 | 25 | 60 | 4 |
| 4047 | 37°05' N. | 10°25' E. | 95 | 1-5-30 | 20$^{00}$ | S. 200 | 25, 50 | 60 | 4, 4 |
| 4048 | 37°42' N. | 11°22' E. | 625, 550, 610 | 2-5-30 | 3$^{15}$ | S. 200 | 250, 350, 450 | 120 | 1, 3, 1 |
| 4050 | 38°48' N. | 12°06' E. | 1950—1875 | 3-5-30 | 2$^{00}$—4$^{00}$ | S. 200 | 50, 150, 200,<br>250, 300 | 90 | 1, 2, 1,<br>4, 3 |
| 4051 | 38°47' N. | 14°04' E. | 1850 | 4-5-30 | 1$^{40}$ | S. 200 | 50, 100, 200 | 90 | 2, 2, 1 |
| 4052 | 39°04' N. | 15°29' E. | 1950—2010 | 5-5-30 | 1$^{40}$ | S. 200 | 100, 150, 200,<br>250 | 90 | 2, 2, 2, 1 |
| 4054 | 38°00' N. | 15°33' E. | 1125—1070 | 5-5-30 | 19$^{30}$—21$^{30}$ | S. 200 | 50, 100, 150,<br>200, 250 | 90 | 2, 2, 1<br>2, 1 |
| 4055 | 38°12,5' N. | 15°36' E. | 225, 105—<br>135, 175 | 6-5-30 | 3$^{30}$ | S. 200 | 50, 100, 125 | 90 | 1, 1, 2 |
| 4056 | 38°28' N. | 15°38' E. | 690—1100 | 6/7-5-30 | 19$^{30}$—3$^{30}$ | S. 200 | 50, 100, 150,<br>200, 250 | 90 | 2, 2, 1,<br>1, 2 |
| 4057 | 38°11' N. | 15°38' E. | 240—80 | 7-5-30 | 10$^{00}$ | S. 200 | 100 | 90 | 4 |
| 4058 | 37°19,5' N. | 15°22' E. | 1510 | 7-5-30 | 19$^{30}$ | S. 200 | 100, 150,<br>200, 250 | 90 | 6, 2<br>1, 3 |
| 4059 | 35°59' N. | 15°44' E. | 2250—1175 | 10-5-30 | 3$^{30}$ | S. 200 | 100, 150, 200 | 90 | 1, 2, 2 |
| 4060 | 36°47' N. | 15°21' E. | 1220—2750 | 10/11-5-30 | 23$^{30}$—1$^{30}$ | S. 200 | 50, 100,<br>150, 250 | 90 | 1, 2<br>1, 2 |
| 4061 | 37°47' N. | 15°22' E. | 1100 | 11-5-30 | 19$^{30}$ | S. 200 | 100, 150, 250 | 90 | 2, 3, 2 |
| 4062 | 36°40' N. | 17°40' E. | 3250 | 12-5-30 | 20$^{30}$ | S. 200 | 100, 300 | 90 | 2, 2 |
| 4063 | 36°18' N. | 18°20' E. | 3850 | 13-5-30 | 3$^{30}$ | S. 200<br>E. 1000 | 100, 200, 300<br>600, 1000 | 90 | 2, 1, 2<br>2, 1 |
| 4065 | 35°22' N. | 19°28' E. | 3075 | 13-5-30 | 20$^{30}$ | S. 150<br>S. 200 | 100, 200,<br>300, 600, 950 | 90 | 2, 2,<br>1, 1, 1 |
| 4066 | 35°00' N. | 20°04' E. | 2840 | 14-5-30 | 3$^{00}$ | S. 200 | 50, 200 | 90 | 2, 2 |
| 4067 | 33°36' N. | 22°07' E. | 1925 | 14-5-30 | 19$^{50}$ | S. 200 | 150, 200 | 90 | 2, 2 |
| 4069 | 34°48' N. | 22°26' E. | 2900 | 15-5-30 | 19$^{40}$ | S. 200 | 150 | 90 | 6 |
| » | » | » | 2900 | » | 23$^{50}$ | S. 150 | 950 | » | 1 |
| » | » | » | » | » | » | S. 200 | 600 | » | 4 |
| » | » | » | » | » | » | S. 200 | 300 | » | 1 |
| » | » | » | » | » | » | S. 200 | 200 | » | 5 |
| » | » | » | 2975 | » | » | S. 200 | 100 | » | 2 |
| 4070 | 35°10,5' N. | 21°54' E. | 4040 | 16-5-30 | 16$^{50}$ | S. 150 | 4000 | 120 | 2 |
| » | » | » | 3700 | » | 17$^{50}$ | S. 150 | 2000 | » | 2 |
| » | » | » | 4060—3750 | » | 21$^{00}$—23$^{00}$ | S. 200 | 250 | 90 | 3 |
| » | » | » | » | » | » | S. 200 | 200 | » | 1 |
| » | » | » | 3575 | 17-5-30 | 1$^{10}$ | S. 150 | 950 | » | 4 |
| » | » | » | » | » | » | S. 200 | 600 | » | 3 |
| » | » | » | » | » | » | S. 200 | 300 | » | 7 |
| » | » | » | » | » | » | S. 200 | 100 | » | 3 |
| » | » | » | 3950 | » | 5$^{45}$ | P. 100 | 400 | 60 | 3 |
| 4071 | 36°59' N. | 23°29' E. | 680 | 17-5-30 | 21$^{30}$ | S. 200 | 600 | 90 | 2 |
| » | » | » | 710 | 18-5-30 | 1$^{00}$ | S. 200 | 1000 | » | 10 |
| 4075 | 38°29' N. | 20°08' E. | 2160 | 21-5-30 | 22$^{10}$ | S. 200 | 150 | 90 | 1 |
| » | » | » | 2210 | 22-5-30 | 0$^{15}$ | S. 200 | 250 | » | 1 |
| » | » | » | » | » | » | S. 200 | 200 | » | 2 |
| » | » | » | 2050 | » | 2$^{30}$ | S. 200 | 600 | » | 4 |
| » | » | » | » | » | » | S. 200 | 300 | » | 6 |
| » | » | » | » | » | » | S. 200 | 100 | » | 6 |
| » | » | » | » | » | » | S. 200 | 50 | » | 10 |
| 4076 | 38°28' N. | 18°21' E. | 2240 | 23-5-30 | 0$^{10}$ | S. 200 | 250 | 90 | 2 |
| » | » | » | » | » | » | S. 200 | 200 | » | 6 |
| » | » | » | » | » | » | S. 200 | 150 | » | 4 |
| » | » | » | » | » | 2$^{10}$ | S. 200 | 50, 100,<br>300, 600 | » | 4, 3,<br>2, 1 |
| 4077 | 37°32' N. | 15°51' E. | 1700 | 23-5-30 | 20$^{30}$ | S. 200 | 250 | 90 | 4 |
| » | » | » | 1700—1880 | » | 20$^{30}$—22$^{30}$ | S. 200 | 150 | » | 10 |
| » | » | » | 1875 | » | 22$^{30}$ | S. 200 | 50 | » | 1 |
| 4078 | 37°50' N. | 15°32' E. | 1550 | 24-5-30 | 2$^{40}$ | S. 200 | 150 | 90 | 3 |

| Station Nr. | Lat. | Long. | Depth Metres | Date | Hour | Gear | Wire out Metres | Duration of haul in minutes | Number of specimens |
|---|---|---|---|---|---|---|---|---|---|
| **"Dana"** | | | | | | | | | |
| 4079 | 39°54′ N. | 14°49′ E. | 680 | 24-5-30 | $20^{30}$ | S. 200 | 250 | 90 | 7 |
| » | » | » | 680—1160 | » | $20^{30}$ $22^{30}$ | S. 200 | 200 | » | 10 |
| » | » | » | » | » | » | S. 200 | 150 | » | 15 |
| » | » | » | » | » | » | S. 200 | 100 | » | 10 |
| 4089 | 40°29′ N. | 14°16′ E. | 1000 | 26-5-30 | $23^{20}$ | S. 200 | 250 | 90 | 5 |
| » | » | » | 1000—1025 | 26/27-5-30 | $23^{20}$ $1^{20}$ | S. 200 | 200 | » | 4 |
| » | » | » | » | » | » | S. 200 | 150 | » | 16 |
| » | » | » | » | » | » | S. 200 | 100 | » | 2 |
| » | » | » | 1050 | 27-5-30 | $3^{30}$ | S. 150 | 950 | » | 1 |
| » | » | » | » | » | » | S. 200 | 600 | » | 2 |
| » | » | » | » | » | » | S. 200 | 100 | » | 6 |
| » | » | » | 1020 | » | » | S. 200 | 50 | » | 4 |
| 4107 | 40°28′ N. | 14°15′ E. | 1040—950 | 27/28-5-30 | $22^{45}$ $0^{45}$ $2^{45}$ | S. 200 | 250 | 90 | 10 |
| » | » | » | » | » | » | S. 200 | 200 | » | 10 |
| » | » | » | » | » | » | S. 200 | 150 | » | 10 |
| » | » | » | » | » | » | S. 200 | 100 | » | 6 |
| 4118 | 40°35′ N. | 13°40′ E. | 1440 | 29-5-30 | $22^{40}$ | S. 200 | 250 | 90 | 4 |
| 4119 | 40°13′ N. | 12°06′ E. | 3375 | 30-5-30 | $15^{30}$ | S. 200 | 1600 | 45 | 1 |
| » | » | » | » | » | » | P. 100 | 1500 | » | 4 |
| » | » | » | 2700 | » | $19^{45}$ | S. 150 | 4000 | 120 | 5 |
| » | » | » | » | » | » | S. 150 | 3000 | » | 6 |
| » | » | » | 3350 | » | $23^{30}$ | S. 200 | 100 | 90 | 2 |
| » | » | » | » | » | » | S. 200 | 50 | » | 2 |
| » | » | » | 2400 | 31-5-30 | $1^{50}$ | S. 200 | 250 | » | 3 |
| » | » | » | » | » | » | S. 200 | 200 | » | 3 |
| » | » | » | » | » | » | S. 200 | 150 | » | 4 |
| 4120 | 38°34′ N. | 13°12′ E. | 1825 | 31-5-30 | $22^{20}$ | S. 200 | 100 | 90 | 1 |
| 4121 | 38°22′ N. | 13°04′ E. | 950 | 1-6-30 | $0^{50}$ | S. 200 | 250 | 120 | 3 |
| » | » | » | » | » | » | S. 200 | 200 | » | 2 |
| » | » | » | » | » | » | S. 200 | 100 | » | 5 |
| 4122 | 38°27′ N. | 10°20′ E. | 2000 | 1-6-30 | $20^{00}$ | S. 200 | 250 | 90 | 7 |
| » | » | » | » | » | » | S. 200 | 200 | » | 13 |
| » | » | » | » | » | » | S. 200 | 150 | » | 3 |
| 4123 | 38°20′ N. | 10°16′ E. | 1200 | 1-6-30 | $22^{30}$ | S. 200 | 250 | 90 | 2 |
| » | » | » | » | » | » | S. 200 | 200 | » | 4 |
| » | » | » | » | » | » | S. 200 | 100 | » | 10 |

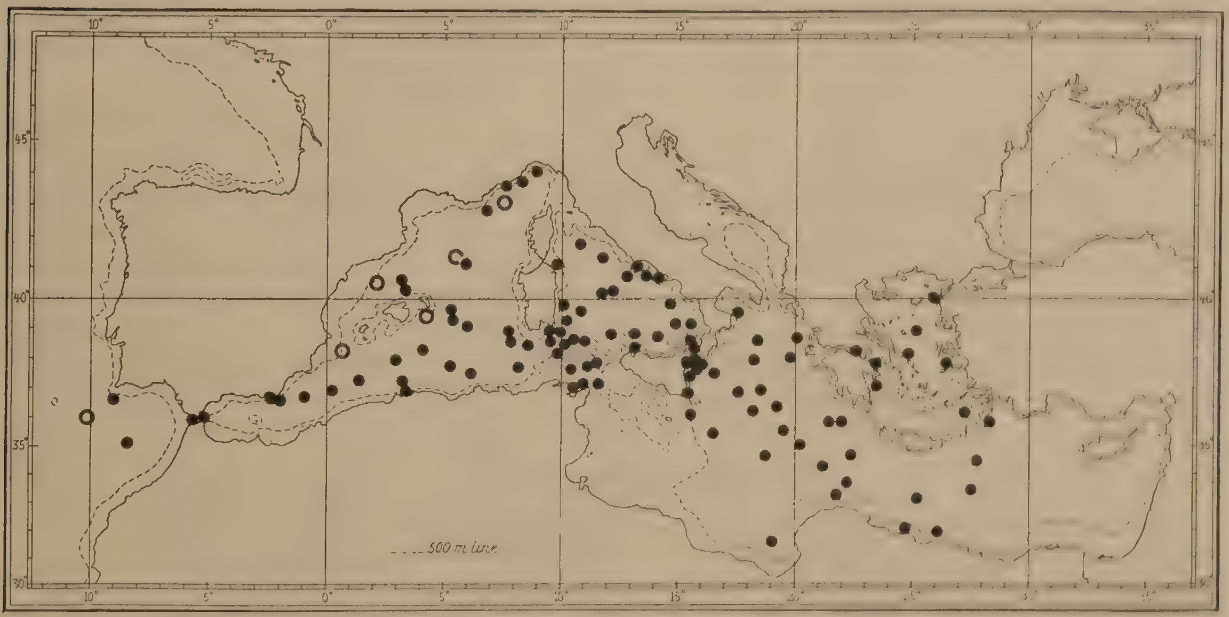

Chart 15. Occurrence of *Vanadis formosa* Claparède.

● new records. ○ previous records.

This Alciopid attains a length of abt. 30 cm. by 5—6 mm.; the number of segments is more than 200. The colour is transparent yellowish-white, the enormous, ventrally turned eyes are red and the pigment cushions dark brown. The head is very short and broad due to the big eyes; the proboscis is enormous, white, with two long, subulate lateral processes and 4 smaller protrusions between them dorsally as well as ventrally. One small median digitiform antenna and two pairs of lateral ones. In the female the dorsal cirri of the first two feet are transformed into seminal pouches, which when filled with sperma may be very voluminous (in fig. 20 they are empty). In these feet the pedal lobe is absent. In the male only the first pair is rudimentary; the following feet are all normal, furnished with two foliaceous cirri, a lanceolate pedal lobe which ends in a small cirriform appendage and in which the aciculum is long and projecting. The bristles are all similar, very long, compound, hirsute swimming-bristles, the terminal joint only $^{1}/_{6}$—$^{1}/_{8}$ of the whole bristle. Every segment except the first three carries a large brown gland. One unpaired, long anal cirrus,

Hardly a single specimen is complete; the species unfortunately is very liable to break into lots of fragments, often only consisting of 2—3 segments.

Beyond doubt *Vanadis formosa* is the most common Alciopid in the material; we may even say from this investigation the most common in the Mediterranean, where scattered finds from the Gulf of Naples and the Western parts had previously been made. Evidently it decreases in numbers eastwards and is especially abundant in the Tyrrhenian Sea. It is noticeable that it penetrates rather far into the Levant and the Ægean Sea. It is a typical oceanic form occurring most frequently in the upper water-layers. It is found at all seasons. According to the lists above these do not seem to influence its bathymetrical range.

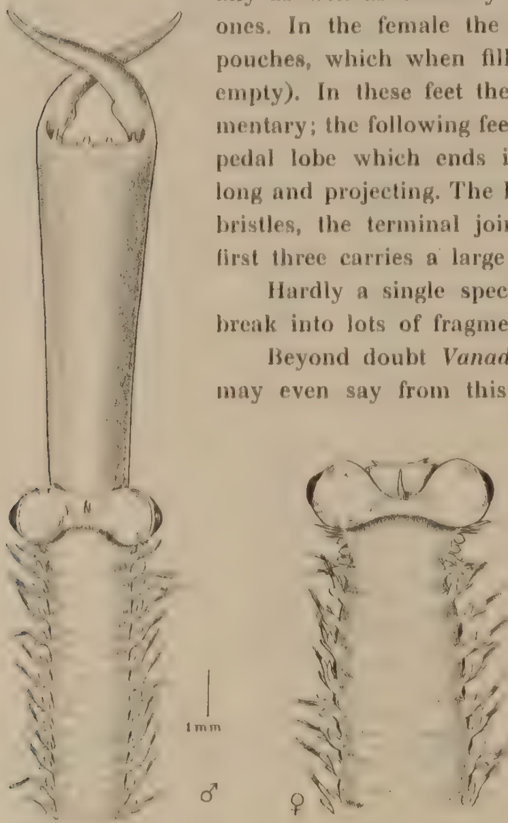

Fig. 20. *Vanadis formosa* Claparède.

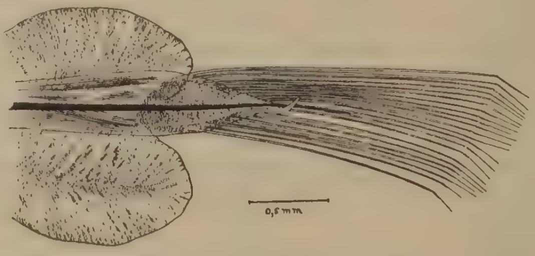

Fig. 21. *Vanadis formosa* Claparède. Parapodium from the middle part of the body.

*Vanadis formosa* is widely spread in the temperate and tropical zones of the Atlantic and is known from the Indian Ocean and the Pacific as well.

## VANADIS CRYSTALLINA Greeff.

*Vanadis crystallina* Greeff 1876, p. 68.
*Alciopa longirhyncha* Greeff 1876, p. 453.
*Alciopa candida* Hering 1892, p. 732.
*Vanadis crystallina* Apstein 1900, p. 66.
*Vanadis crystallina* Lo Bianco 1904, p. 50.
*Vanadis crystallina* Fauvel 1916, p. 66.
*Vanadis crystallina* Fauvel 1923, p. 202.
*Vanadis crystallina* Fauvel 1932, p. 17.
*Vanadis crystallina* Monro 1936, p. 116.

## Material.

| Station Nr. | Lat. | Long. | Depth Metres | Date | Hour | Gear | Wire out Metres | Duration of haul in minutes | Number of specimens |
|---|---|---|---|---|---|---|---|---|---|
| **"Thor"** | | | | | | | | | |
| 10 | 37°21′ N. | 16°45′ E. | > 2100 | 15-12-08 | $6^{10}$ | Y. 200 | 65 | 60 | 6 |
| 11 | 36°57′ N. | 18°16′ E. | > 3700 | 16-12-08 | $5^{25}$ | Y. 200 | 65 | 60 | 5 |
| 24 | 40°14′ N. | 12°23′ E. | > 3700 | 16-1-09 | $21^{10}$ | Y. 200 | 300 | 30 | 1 |
| 30 | 41°15′ N. | 11°55′ E. | > 1800 | 21-1-09 | $7^{10}$ | Y. 200 | 300 | 60 | 1 |
| 31 | 41°44′ N. | 10°52′ E. | 1420 | 22-1-09 | $3^{50}$ | Y. 200 | 200 | 30 | 2 |
| 39 | 39°41′ N. | 10°02′ E. | 1750 | 1-2-09 | $5^{00}$ | Y. 200 | 25 | 60 | 4 |
| 40 | 39°10′ N. | 9°40′ E. | 235 | 1-2-09 | $21^{30}$ | Y. 200 | 65 | 30 | 1 |
| 45 | 37°28′ N. | 8°18′ E. | > 2150 | 6-2-09 | $23^{25}$ | Y. 200 | 300 | 30 | 3 |
| 89 | 36°28′ N. | 8°22′ W. | 1310 | 18-6-10 | $3^{00}$ | Y. 200 | 65 | 15 | 1 |
| 115 | 38°17′ N. | 4°11′ E. | 2800 | 29-6-10 | $0^{30}$ | Y. 200 | 2000 | 60 | 1 |
| » | » | » | » | » | $1^{20}$ | Y. 200 | 65 | 15 | 3 |
| 116 | 39°27′ N. | 5°26′ E. | 2860 | 30-6-10 | $3^{00}$ | Y. 200 | 25 | 15 | 4 |
| 123 | 44°14′ N. | 8°55′ E. | ca. 700 | 3-7-10 | $1^{50}$ | Y. 200 | 25 | 15 | 1 |
| 131 | 38°36′ N. | 11°00′ E. | 915 | 13-7-10 | $9^{50}$ | Y. 200 | 25 | 30 | 2 |
| 132 | 38°57′ N. | 9°47′ E. | 1227 | 14-7-10 | $3^{05}$ | Y. 200 | 25 | 30 | 2 |
| 133 | 38°18′ N. | 9°59′ E. | 602 | 14-7-10 | $23^{00}$ | Y. 200 | 25 | 30 | 3 |
| 137 | 37°17′ N. | 10°56′ E. | 190 | 19-7-10 | $8^{15}$ | Y. 200 | 25 | 30 | 3 |
| 138 | 37°37′ N. | 11°25′ E. | 788 | 19-7-10 | $19^{40}$ | Y. 200 | 1000 | 60 | 6 |
| » | » | » | » | »» | $21^{50}$ | Y. 200 | 25 | 30 | 6 |
| 160 | 35°59′ N. | 28°14′ E. | > 1000 | 1-8-10 | $2^{00}$ | Y. 200 | 25 | 30 | 27 |
| » | » | » | » | » | $2^{45}$ | Y. 200 | 300 | » | 1 |
| » | » | » | 2980 | » | $14^{20}$ | Y. 200 | 25 | » | 3 |
| 183 | 37°52′ N. | 23°09′ E. | 233 | 16-8-10 | $17^{10}$ | Y. 200 | 65 | 15 | 10 |
| 186 | 37°57′ N. | 19°51′ E. | > 3000 | 17-8-10 | $20^{15}$ | Y. 200 | 300 | 15 | 3 |
| 190 | 37°51′ N. | 15°19′ E. | 360 | 19-8-10 | $20^{15}$ | Y. 200 | 25 | 15 | 3 |
| 193 | 38°15′ N. | 15°39′ E. | > 100 | 21-8-10 | $0^{50}$ | Y. 200 | 10 | 30 | 2 |
| 194 | 38°33′ N. | 15°29′ E. | 1140 | 21-8-10 | $4^{30}$ | Y. 200 | 10 | 15 | 10 |
| » | » | » | » | » | $5^{00}$ | Y. 200 | 25 | » | 2 |
| 195 | 39°02′ N. | 14°55′ E. | ca. 3160 | 21-8-10 | $18^{50}$ | Y. 200 | 65 | 15 | 6 |
| 196 | 39°59′ N. | 14°31′ E. | > 600 | 22-8-10 | $2^{40}$ | Y. 200 | 25 | 30 | 5 |
| 199 | 39°32′ N. | 10°49′ E. | ca. 2700 | 25-8-10 | $21^{00}$ | Y. 200 | 25 | 15 | 3 |
| 205 | 39°16′ N. | 5°52′ E. | ca. 2860 | 27-8-10 | $19^{35}$ | Y. 200 | 25 | 15 | 3 |
| 206 | 39°32′ N. | 5°15′ E. | ca. 2860 | 28-8-10 | $0^{30}$ | Y. 200 | 25 | 15 | 4 |
| 279 | 38°11.5′ N. | 15°36.5′ E. | 350 | 23-2-11 | $19^{00}$ | S. 100 | 30 | 120 | 2 |
| 281 | 38°15′ N. | 15°37.5′ E. | 5—8 | 1-3-11 | $15^{44}$ | S. 100 | 30 | 120 | 1 |
| 282 | 38°12′ N. | 15°37′ E. | 200 | 8-3-11 | $17^{30}$ | S. 100 | 40 | 90 | 2 |
| 339 | 40°30′ N. | 3°10′ E. | > 2000 | 20-8-11 | $3^{00}$ | S. 200 | 28 | 30 | 2 |
| 340 | 35°50′ N. | 21°30′ E. | > 2000 | 26-8-11 | $21^{00}$ | S. 150 | 108 | 30 | 1 |
| 341 | 34°00′ N. | 26°20′ E. | > 2000 | 27-8-11 | $23^{00}$ | S. 200 | 28 | 30 | 3 |
| **"Dana"** | | | | | | | | | |
| 1108 | 35°11′ N. | 8°28′ W. | ? | 14-9-21 | $20^{15}$ | S. 200 | 50 | 120 | 4 |
| 1120 | 36°24′ N. | 1°00′ W. | ? | 24-9-21 | $2^{00}$ | S. 200 | 100 | 120 | 4 |
| 1122 | 37°12′ N. | 1°08′ E. | ? | 25-9-21 | $21^{30}$ | S. 200 | 150 | 120 | 3 |
| 1123 | 37°48′ N. | 2°44′ E. | ? | 26-9-21 | $18^{40}$ | S. 200 | 50 | 120 | 6 |
| 1124 | 37°15′ N. | 2°55′ E. | ? | 27-9-21 | $3^{20}$ | S. 200 | 100, 150 | 120 | 7, 2 |
| 4019 | 33°08′ N. | 10°22′ W. | 4125 | 30-3-30 | $18^{30}$ | S. 200 | 300 | 120 | 8 |
| 4048 | 37°42′ N. | 11°22′ E. | 550 | 2-5-30 | $3^{15}$ | S. 200 | 350 | 120 | 2 |
| 4050 | 38°48′ N. | 12°06′ E. | 1950—1875 | 3-5-30 | $4^{00}$ | S. 200 | 150, 200, 300 | 90 | 4, 2, 1 |
| 4051 | 38°47′ N. | 14°04′ E. | 1850 | 4-5-30 | $1^{40}$ | S. 200 | 50 | 90 | 6 |
| 4052 | 39°04′ N. | 15°29′ E. | 2010—1825 | 5-5-30 | $3^{15}$ | S. 200 | 100, 150, 200, 250 | 120 | 3, 2, 2, 1 |
| 4054 | 38°00′ N. | 15°33′ E. | 1070—925 | 5-5-30 | $23^{15}$ | S. 200 | 50, 200 | 90 | 4, 4 |
| 4055 | 38°12.5′ N. | 15°36′ E. | 125 | 6-5-30 | $5^{30}$ | S. 200 | 50—100 | 90 | 6, 4 |
| 4056 | 38°28′ N. | 15°38′ E. | 1100 | 7-5-30 | $3^{20}$ | S. 200 | 100, 150, 200 | 90 | 4, 3, 3 |
| 4058 | 37°19.5′ N. | 15°22′ E. | 1510—1340 | 7-5-30 | $19^{30}$ $23^{30}$ | S. 200 | 25, 150 | 90 | 2, 2 |
| 4059 | 35°59′ N. | 15°44′ E. | 1980 | 9-5-30 | $23^{30}$ | S. 200 | 200 | 90 | 7 |
| 4060 | 36°47′ N. | 15°21′ E. | 2700 | 11-5-30 | $3^{20}$ | S. 200 | 300—350 | 90 | 6, 5 |
| 4061 | 37°47′ N. | 15°22′ E. | 1485 | 12-5-30 | $1^{30}$ | S. 200 | 200—250 | 90 | 7, 5 |
| 4063 | 36°18′ N. | 18°20′ E. | 3850 | 13-5-30 | $3^{20}$ | S. 200 | 200 | 90 | 8 |
| 4065 | 35°22′ N. | 19°28′ E. | 3075 | 13-5-30 | $20^{20}$ | S. 150 | 950 | 90 | 2 |
| 4066 | 35°00′ N. | 20°04′ E. | 2840 | 14-5-30 | $3^{00}$ | S. 200 | 50, 100, 300 | 90 | 6, 5, 5 |
| 4067 | 33°36′ N. | 22°07′ E. | 1800 | 15-5-30 | $0^{30}$ | S. 200 | 50, 100, 200 | 90 | 9, 3, 3, |
| 4071 | 36°59′ N. | 23°29′ E. | 680 | 17-5-30 | $21^{20}$ | S. 200 | 100 | 90 | 1 |
| 4075 | 38°29′ N. | 20°08′ E. | 2050 | 22-5-30 | $2^{30}$ | S. 200 | 50 | 90 | 4 |
| 4089 | 40°29′ N. | 14°16′ E. | 1000—1025 | 26/27-5-30 | $23^{20}$ $1^{20}$ | S. 200 | 150 | 90 | 10 |
| » | » | » | » | » | » | S. 200 | 100 | » | 5 |
| » | » | » | 1050 | 27-5-30 | $3^{30}$ | S. 200 | 100 | » | 6 |
| » | » | » | 1020 | » | » | S. 200 | 50 | » | 6 |
| 4118 | 40°35′ N. | 13°40′ E. | 1480 | 29-5-30 | $22^{40}$ | S. 200 | 100 | 90 | 8 |
| 4119 | 40°13′ N. | 12°06′ E. | 3350 | 30-5-30 | $23^{30}$ | S. 200 | 50 | 90 | 3 |
| 4122 | 38°27′ N. | 10°20′ E. | 2000 | 1-6-30 | $20^{00}$ | S. 200 | 150 | 90 | 3 |

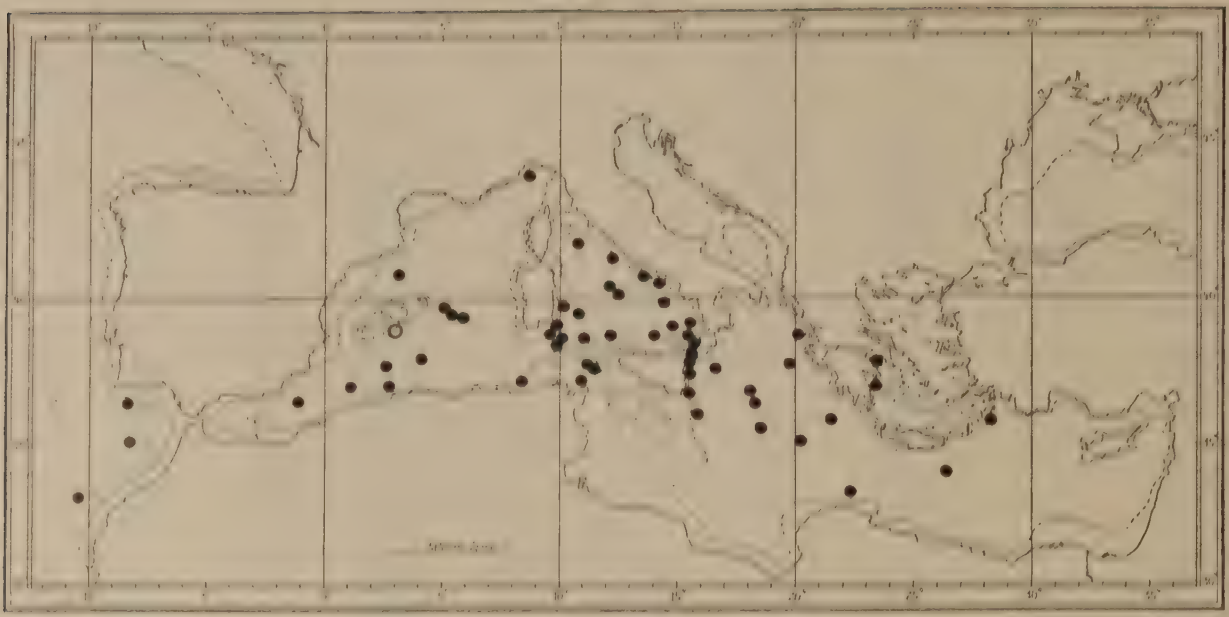

Chart 16. Occurrence of *Vanadis crystallina* Greeff.

● new records. ○ previous record.

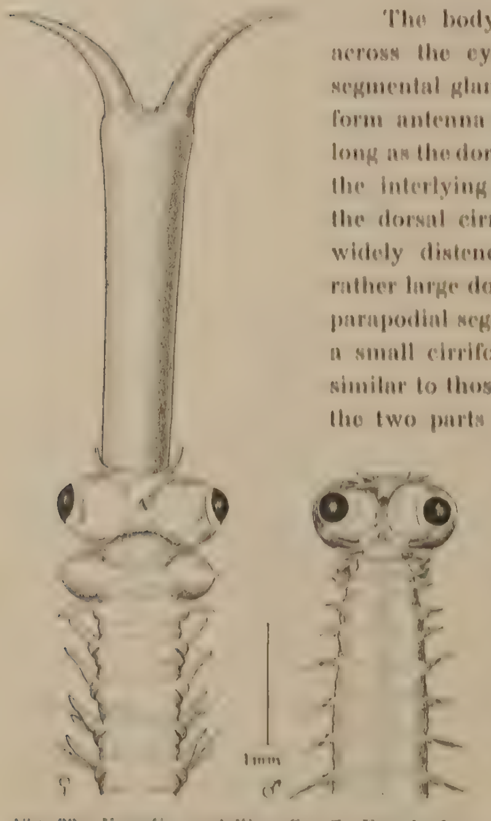

Fig. 22. *Vanadis crystallina* Greeff. Female from the dorsal, male from the ventral side.

The body is filiform, 3—8 cm. by 1.5—0.75 mm.; the greatest breadth is across the eyes. Abt. 150 segments. Perfectly transparent except the brown segmental glands and the red, ventrally or laterally turned eyes. One little digitiform antenna between the eyes; 2 pairs of antennæ, the ventral pair twice as long as the dorsal. Proboscis enormous with two long lateral processes and without the interlying rounded papillæ. 4 pairs of tentacular cirri. In the female only the dorsal cirrus of the first foot is converted into seminal pouches (in fig. 22 widely distended with sperma). Altogether there are 5 rudimentary feet with rather large dorsal and smaller ventral cirri but without pedal lobes. From the 6th parapodial segment the feet are normal, consisting of a lanceolate pedal lobe with a small cirriform appendix and a hardly projecting aciculum. The bristles are similar to those of *Vanadis formosa* but still more delicate; the articulation between the two parts is often difficult to see. The segmental glands are comparatively inconspicuous; they are formed as thin transversal bands laterally on the body. Two short pygidial styles which often are lost.

By far the greater part of the tiny specimens are broken to pieces. The species was previously known from S. of the Balearic Islands. This material substantiates that it is spread all over this sea, less frequent, however, in the eastern parts than *V. formosa*.

*V. crystallina* is a pronounced oceanic species. It is noteworthy that by far the greater part of the hauls were made late in the evening or in the night; like so many pelagic animals it evidently rises to the surface in the night.

The species is widely distributed in the temperate and tropic areas of the Atlantic.

## GREEFFIA OAHUENSIS McIntosh.

*Greeffia oahuensis* McIntosh 1885, p. 182.
*Greeffia oahuensis* Monro 1900, p. 82.
*Greeffia oahuensis* Monro 1936, p. 118.

Material.

| Station Nr. | Lat. | Long. | Depth Metres | Date | Hour | Gear | Wire out Metres | Duration of haul in minutes | Number of specimens |
|---|---|---|---|---|---|---|---|---|---|
| "Thor" | | | | | | | | | |
| 82 | 51°00′ N. | 11°43′ W. | 1340 | 14-6-05 | $11^{00}$ | Y. 330 | 300 | 120 | 2 |
| 93 | 49°25′ N. | 12°20′ W. | 1280 | 24-6-05 | $15^{30}$ | Y. 330 | 300 | 60 | 3 |
| 52 | 48°43′ N. | 12°05′ W. | 1860 | 21-5-06 | $0^{25}$ | Y. 330 | 300 | 120 | 3 |
| 62 | 50°25′ N. | 12°44′ W. | 2480 | 4-6-06 | $9^{55}$ | Y. 330 | 300 | 120 | 2 |
| 80 | 51°34′ N. | 11°50′ W. | 1140 | 16-6-06 | $18^{30}$ | Y. 200 | 1200 | 120 | 1 |
| 168 | 51°30′ N. | 11°37′ W. | 470—450 | 26-8-06 | $23^{55}$ | Y. 330 | 300 | 300 | 2 |
| 175 | 51°11′ N. | 11°41′ W. | 880 | 30-8-06 | $23^{55}$ | Y. 330 | 300 | 60 | 2 |
| 233 | 36°49′ N. | 9°15′ W. | 658 | 10-9-10 | $5^{05}$ | Y. 200 | 25 | 15 | 1 |
| "Dana" | | | | | | | | | |
| 4000 | 0°31′ S. | 11°02′ W. | 3760 | 4-3-30 | $2^{30}$ | S. 200 | 300 | 120 | 3 |

The body of the longest of the specimens measures 4.5 cm. by 4 mm.; one of the specimens which is incomplete, only the foremost end is present, must however have been considerably longer, the breadth being almost 8 mm. The body tapers gradually towards the hind end which in all specimens is incomplete; it looks as if a median appendage has been lost. The colour is yellow, the enormous segmental glands dark brown, almost black; they extend dorsally as well as ventrally to the feet. The eyes are globular and very large, the cornea turning sidewards or a little downwards. The proboscis is very compact with two long and slender, subulate lateral processes. The prostomium extends only little beyond the eyes; it is slightly arched in front and carries a single knot-like antenna between the eyes and two pairs of subulate antennæ, the ventral one being the longest. 3 pairs of tentacular cirri, the middle longer than the others. The first chaetiger carries a small, conical, pedal lobe with a few bristles and small, but not rudimentary, foliaceous dorsal and ventral cirri. In the rest of the segments both cirri are of enormous size, ovato-cordiform. The pedal lobe has the generic character: the two small cirriform appendages; the aciculum is hardly projecting from the tip. The bristles are all similar, long hirsute, compound swimming-bristles with a delicate terminal point attached laterally "a small portion of the tip of the shaft being visible beyond the point of function" (McIntosh 1885, p. 183).

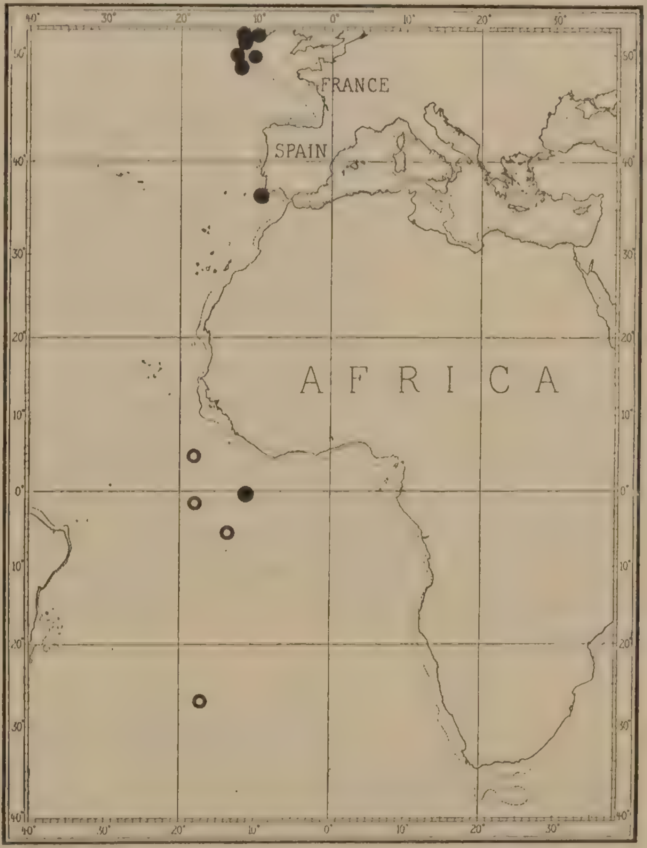

Chart 17. Occurrence of *Greeffia oahuensis* McIntosh.
● new records. ○ previous records.

The species is nearly related to *G. celox* (Greeff). According to Monro it only differs from this by possessing 3 pairs of tentacular cirri; *G. celox* has 4 pairs. To verify this I examined the material of this genus in the collections of the Zoological Museum labelled *G. celox*, all from tropic and subtropic parts of the Atlantic, and I found to my astonishment that they all possessed 3 pairs of tentacles; they thus all belong to the species *G. oahuensis*. In order to ascertain whether the great material of Alciopids collected by the "Dana" in the Atlantic contained *G. celox*, some random samples were taken out; all the specimens proved to be *G. oahuensis*. Thus I was unable to compare the two species.

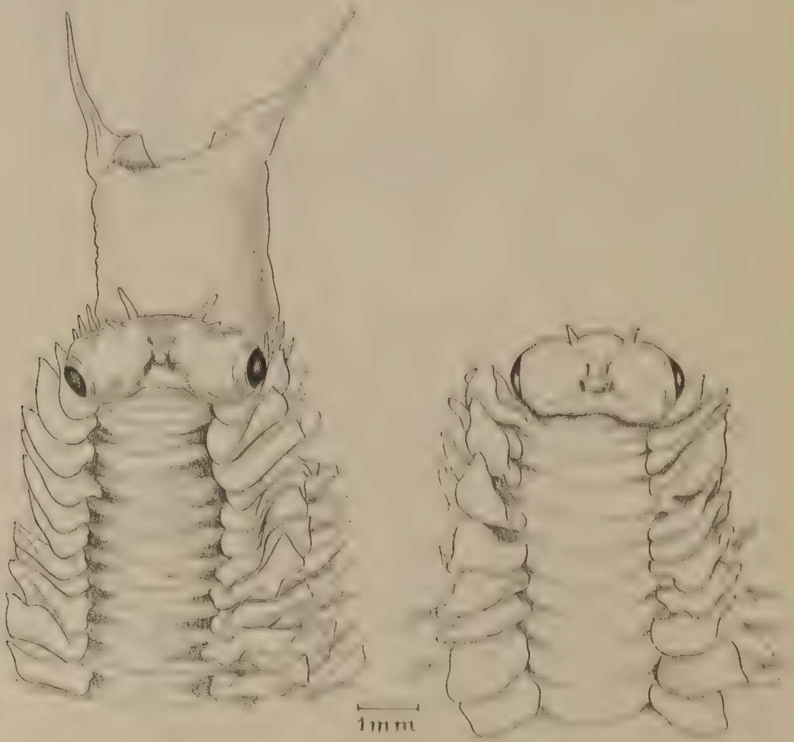

Fig. 23. *Greeffia oahuensis* McIntosh. Dorsal views.

According to the list of habitats the specimens available come from south-west of England and off Cape St. Vincent. In all likelihood the English localities are at the northernmost limit of the distribution of the species. They are taken fairly close to the shore in the upper water-layers above fairly small depths, and it is therefore remarkable that they do not cross the threshold at Gibraltar. Nor is *G. celox* known from the Mediterranean.—If a confusion of the two species has not taken place, they live side by side in the waters of Ireland and South England.

The distribution of *G. oahuensis* is no doubt insufficiently known. The localities signed on the chart are from Monro's Reports on the "Discovery" Expeditions. Originally the species was described from off Honolulu.

## CORYNOCEPHALUS ALBO-MACULATUS Levinsen.

*Alciopina parasitica* Claparède 1868, p. 253.
*Corynocephalus albo-maculatus* Levinsen 1885, p. 327.
*Corynocephalus albo-maculatus* Apstein 1900, p. 14.
*Alciopina parasitica* Granata 1911, p. 7.
*Corynocephalus albo-maculatus* Fauvel 1916, p. 68.
*Corynocephalus albo maculatus* Fauvel 1923, p. 209.

## Material.

| Station Nr. | Lat. | Long. | Depth Metres | Date | Hour | Gear | Wire out Metres | Duration of haul in minutes | Number of specimens |
|---|---|---|---|---|---|---|---|---|---|
| "Thor" | | | | | | | | | |
| 10 | 37°21′ N. | 16°45′ E. | > 2100 | 15-12-08 | $15^{45}$ | Y. 200 | 600 | 60 | 1 |
| 24 | 40°14′ N. | 12°23′ E. | 3700 | 16-1-09 | $14^{10}$ | Y. 200 | 600 | 60 | 1 |
| 129 | 40°05′ N. | 11°31′ E. | 3420 | 12-7-10 | $3^{40}$ | Y. 200 | 300 | 30 | 1 |
| "Dana" | | | | | | | | | |
| 4051 | 38°47′ N. | 14°04′ E. | 2490 | 3-5-30 | $21^{30}$ | S. 200 | 100 | 90 | 2 |
| 4059 | 35°59′ N. | 15°44′ E. | 1980—2725 | 9/10-5-30 | $23^{30}$ $1^{30}$ | S. 200 | 100 | 90 | 1 |
| 4067 | 33°36′ N. | 22°07′ E. | 1950 | 15-5-30 | $3^{00}$ | S. 200 | 200 | 90 | 2 |
| 4079 | 39°54′ N. | 14°49′ E. | 680—1160 | 24-5-30 | $20^{30}$ $22^{30}$ | S. 200 | 150 | 90 | 1 |
| 4089 | 40°29′ N. | 14°16′ E. | 1000 | 26-5-30 | $23^{30}$ | S. 200 | 250 | 90 | 1 |
| » | » | » | 1000—1025 | 26/27-5-30 | $23^{30}$ $1^{30}$ | S. 200 | 200 | » | 1 |
| » | » | » | » | » | » | S. 200 | 150 | » | 1 |
| » | » | » | » | » | » | S. 200 | 100 | » | 2 |
| 4107 | 40°28′ N. | 14°15′ E. | 1040—950 | 27/28-5-30 | $22^{45}$ $0^{45}$ $2^{45}$ | S. 200 | 100 | 90 | 1 |

The largest specimen only measures 12 mm. by 1.75 mm. The colour is orange-yellowish, the eyes red; the brown segmental glands are almost inconspicuous. In the middle of the ventral side of each segment a white spot. Prostomium is small with four blunt, small antennæ and one large club-shaped antenna between the eyes, the hindmost tip of which is free. The proboscis is short, fleshy, without proboscideal tentacles or papillæ. 5 pairs of tentacular cirri; on the first segment one short; on the second and third one short ventral and one long dorsal cirrus. The first chaetiger with big, cordiform dorsal cirrus and a much smaller ventral cirrus and a few simple, strong bristles; in the following chaetigers the ventral cirri are larger but still much smaller than the dorsal one. In all, the three first chaetigers only contain simple bristles; in the rest there are besides these a rather sparse number of long, extremely delicate, capillary, uncompound bristles. In the middlemost parapodia the acicular bristles are only 2—3 in number. From the 10th chaetiger there are large ventral glands, sausage- or pear-shaped;

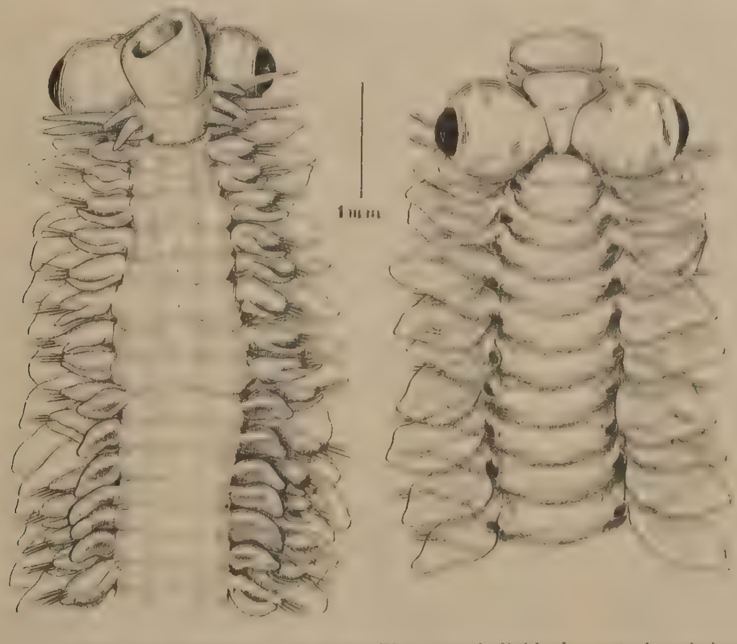

Fig. 24. *Corynocephalus albo-maculatus* Levinsen. The same individual; ventral and dorsal view.

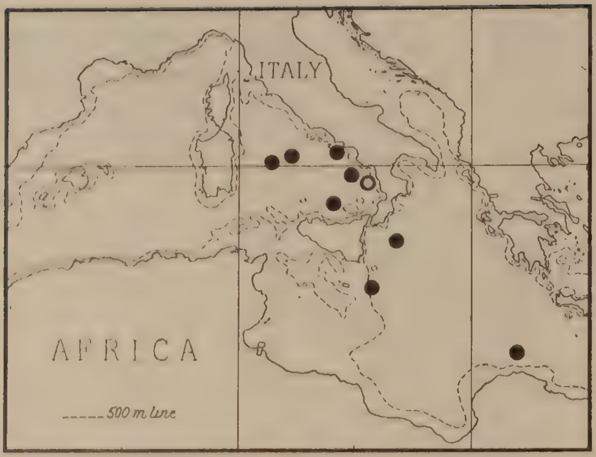

Chart 18. Occurrence of *Corynocephalus albo-maculatus* Levinsen.
● new records. ○ previous record.

when filled with secretion, they are snow-white and shimmering through the body, thus being visible from the dorsal side; they extend backwards in 10—15 segments.

The species was previously known from the Mediterranean (CLAPARÈDE). In the present material it only comes from the central part of this sea. It seems to be an oceanic form in the upper water-layers; it is fairly rare and has been taken chiefly in the summer season and especially in the nocturnal hauls.

The distribution of *C. albo-maculatus* is no doubt incompletely known. It is reported from a number of scattered localities in the warmer parts of the Atlantic (FAUVEL, LEVINSEN a. o.).

(The *Alciopina parasitica* Clap. is according to FAUVEL a. o. to be regarded as a juvenile stage of *Corynocephalus albo-maculatus* Lev. It inhabits the gastrovascular cavity of some Ctenophores (*Cydippe* a. o.) and was originally described from the Gulf of Naples.)

## **CALLIZONELLA LEPIDOTA** (Krohn).

*Alciopa lepidota* Krohn 1845, p. 75.
*Krohnia lepidota* Quatrefages 1865, p. 158.
*Alciopa cirrata* Greeff 1876, p. 60.
*Alciopa lepidota* Hering 1892, p. 752.
*Callizonella lepidota* Apstein 1900, p. 12.
*Callizonella lepidota* Fauvel 1916, p. 67.
*Callizonella lepidota* Fauvel 1923, p. 211.

Material.

| Station Nr. | Lat. | Long. | Depth Metres | Date | Hour | Gear | Wire out Metres | Duration of haul in minutes | Number of specimens |
|---|---|---|---|---|---|---|---|---|---|
| "Thor" | | | | | | | | | |
| 31 | 41°44′ N. | 10°52′ E. | 1420 | 22-1-09 | $3^{50}$ | Y. 200 | 200 | 30 | 2 |
| 39 | 39°41′ N. | 10°02′ E. | 1750 | 1-2-09 | $6^{10}$ | Y. 200 | 65 | 60 | 3 |
| 189 | 37°44′ N. | 15°58′ E. | < 2000 | 19-8-10 | $8^{55}$ | Y. 200 | 300 | 15 | 1 |
| "Dana" | | | | | | | | | |
| 1124 | 37°15′ N. | 2°55′ E. | ? | 27-9-21 | $3^{20}$ | S. 200 | 100 | 120 | 1 |
| 4019 | 33°08′ N. | 10°22′ W. | 4125 | 30-3-30 | $18^{30}$ | S. 200 | 300 | 120 | 2 |
| 4050 | 38°48′ N. | 12°06′ E. | 1950—1875 | 3-5-30 | $2^{00}$ $4^{00}$ | S. 200 | 150, 200<br>250, 300 | 90 | 1 |
| 4051 | 38°47′ N. | 14°04′ E. | 2250—1900 | 4-5-30 | $3^{45}$ | S. 200 | 50—100—300 | 120 | 1 |
| 4052 | 39°04′ N. | 15°29′ E. | 2010 | 5-5-30 | $3^{15}$ | S. 200 | 150—200 | 120 | 1 |
| 4055 | 38°12.5′ N. | 15°36′ E. | 125 | 6-5-30 | $5^{30}$ | S. 200 | 100 | 90 | 1 |
| 4056 | 38°28′ N. | 15°38′ E. | 1100 | 7-5-30 | $3^{20}$ | S. 200 | 100—150—200 | 90 | 2 |
| 4060 | 36°47′ N. | 15°21′ E. | 2700 | 11-5-30 | $3^{30}$ | S. 200 | 300 | 90 | 1 |
| 4061 | 37°47′ N. | 15°22′ E. | 1475 | 12-5-30 | $3^{30}$ | S. 200 | 150—250 | 90 | 1 |
| 4062 | 36°40′ N. | 17°40′ E. | 3250 | 12-5-30 | $20^{20}$ | S. 200 | 600 | 90 | 2 |
| 4063 | 36°18′ N. | 18°20′ E. | 3850 | 13-5-30 | $3^{20}$ | S. 200 | 300 | 90 | 1 |
| 4065 | 35°22′ N. | 19°28′ E. | 3075 | 13-5-30 | $20^{20}$ | S. 200 | 600 | 90 | 1 |
| 4067 | 33°36′ N. | 22°07′ E. | 1800 | 15-5-30 | $0^{30}$ | S. 200 | 50 | 90 | 1 |
| 4069 | 34°48′ N. | 22°26′ E. | 2900 | 15-5-30 | $23^{50}$ | S. 200 | 600 | 90 | 2 |
| 4070 | 35°40.5′ N. | 21°54′ E. | 4075 | 17-5-30 | $5^{15}$ | P. 100 | 600 | 60 | 4 |
| 4089 | 40°29′ N. | 14°16′ E. | 1050 | 27-5-30 | $3^{30}$ | S. 150 | 950 | 90 | 1 |
| 4119 | 40°13′ N. | 12°06′ E. | 3375 | 30-5-30 | $15^{30}$ | P. 100 | 1200 | 45 | 6 |
| » | » | » | 3200 | » | $17^{30}$ | P. 100 | 600 | » | 1 |

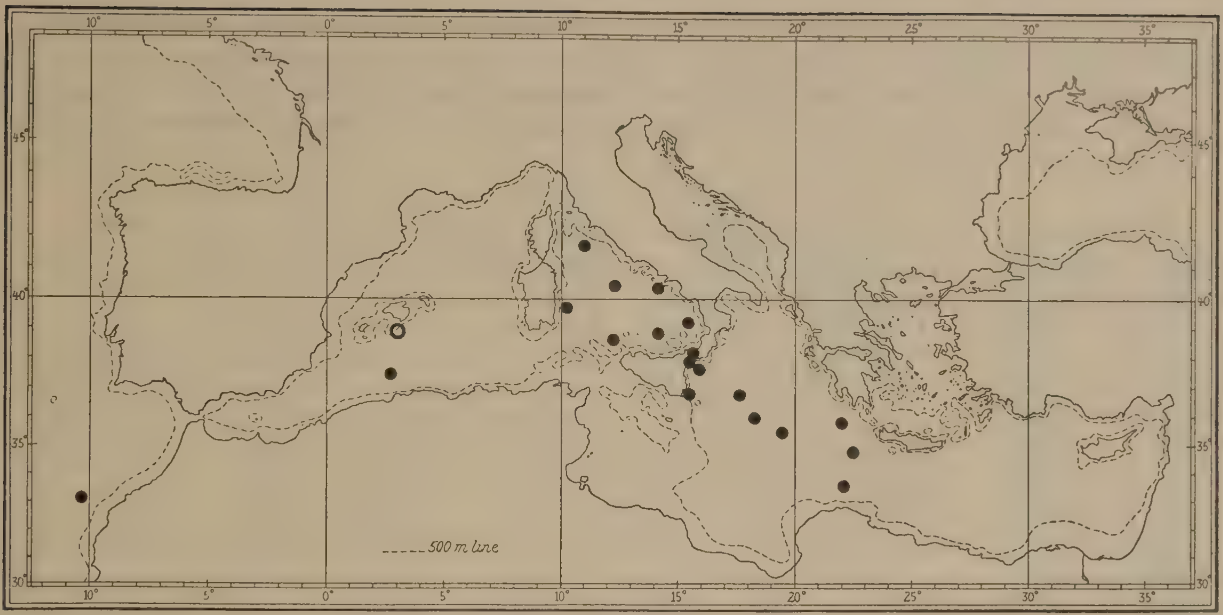

Chart 19. Occurrence of *Callizonella lepidota* (Krohn).
● new records. ○ previous record.

This beautiful little species is very fragile, all the specimens have broken into pieces and the greater part of the dorsal cirri is lost. The colour is yellowish-white, translucent; the large upwards-turned eyes red; brown pigmental stains on the antennæ and tentacular cirri, and in the ventral midline a conspicuous pigment spot on each segment. The segmental glands are not especially pronounced. 100—200 segments, the longest specimen abt. 80 mm. by abt. 2 mm. The prostomium is small, quite outrivalled by the enormous eyes. 2 rather broad, short pairs of antennæ, situated in front of the mouth and—when the proboscis is withdrawn—quite ventrally placed (fig. 25). The unpaired antenna is a pear-shaped little knot. Proboscis is wide, fleshy, crowned by a circle of rounded papillæ. 5 pairs of tentacular cirri, arranged as follows: on the 1st segment one broad cirrus; on the 2nd a dorsal and ventral one almost equally long, and on the 3rd segment one short broad ventral and a dorsal one much longer than any of the others. The feet are all similar, carrying a large foliaceous cirrus ending in a little point and a much smaller ventral one. The uniramous pedal lobe is pointed and furnished with a little cirriform appendix. 2 sorts of bristles, a great number of hirsute, simple bristles and ventrally to them 1 or 2 short, strong simple acicular setæ. In the foremost parapodes the case is entirely the reverse: a majority of acicular setæ.

The species is pelagic in the upper water-layers over great depths. Only very few specimens are taken per haul, in almost equal numbers day and night and almost exclusively in the month of May.

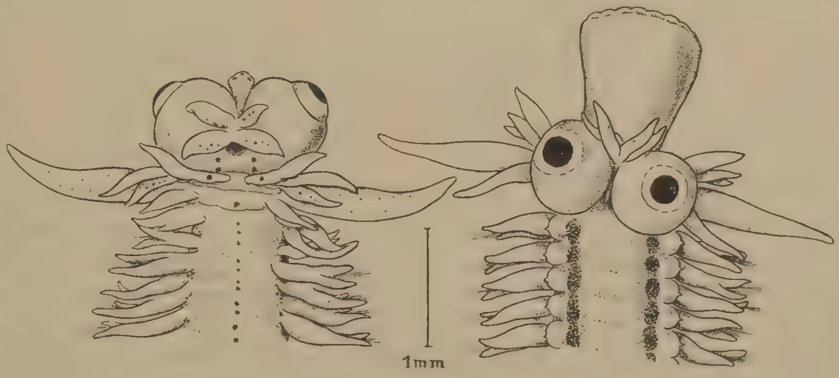

Fig. 25. *Callizonella lepidota* (Krohn). Ventral and dorsal view.

*C. lepidota* was previously known from the Mediterranean and is reported from the tropic and temperate zones of the Atlantic. No doubt, its further distribution is still insufficiently known.

(From Naples Lo Bianco (1904, p. 49) reports *C. lepidota* (Krohn) var. *Krohnii* (Greeff). It is distinguished from the main species by the shape of the dorsal cirri which have a more distinctly elongated tip and are more imbricately arranged.)

## CALLIZONA MOEBII Apstein.

*Callizona Moebii* Apstein 1893, p. 147.
*Callizona Moebii* Apstein 1900, p. 16.
*Callizona Moebii* Fauvel 1923, p. 213.

Material.

| Station Nr. | Lat. | Long. | Depth Metres | Date | Hour | Gear | Wire out Metres | Duration of haul in minutes | Number of specimens |
|---|---|---|---|---|---|---|---|---|---|
| **"Thor"** | | | | | | | | | |
| 24 | 40°14′ N. | 12°23′ E. | > 3700 | 16-1-09 | $23^{15}$ | Y. 200 | 1600 | 240 | 2 |
| 25 | 40°34′ N. | 13°24′ E. | > 1800 | 17-1-09 | $16^{40}$ | Y. 200 | 65 | 30 | 1 |
| 30 | 41°15′ N. | 11°55′ E. | > 1800 | 21-1-09 | $5^{30}$ | Y. 200 | 65 | 60 | 1 |
| 31 | 41°44′ N. | 10°52′ E. | 1420 | 22-1-09 | $3^{50}$ | Y. 200 | 200 | 30 | 1 |
| 39 | 39°41′ N. | 10°02′ E. | 1750 | 1-2-09 | $5^{00}$ | Y. 200 | 25 | 60 | 3 |
| 147 | 31°35′ N. | 19°02′ E. | 993 | 26-7-10 | $0^{20}$ | Y. 200 | 300 | 30 | 1 |
| **"Dana"** | | | | | | | | | |
| 4070 | 35°40.5′ N. | 21°54′ E. | 4050 | 17-5-30 | $4^{45}$ | S. 200 | 1000 | 60 | 1 |
| 4076 | 38°28′ N. | 18°21′ E. | 2240 | 23-5-30 | $0^{10}$ | S. 200 | 250 | 90 | 1 |
| 4077 | 37°32′ N. | 15°51′ E. | 1790—1880 | 23-5-30 | $20^{30}$ $22^{30}$ | S. 200 | 200 | 90 | 1 |
| » | » | » | » | » | » | S. 200 | 150 | » | 1 |
| 4079 | 39°54′ N. | 14°49′ E. | 680—1160 | 24-5-30 | $20^{30}$ $22^{30}$ | S. 200 | 200 | 90 | 1 |
| » | » | » | » | » | » | S. 200 | 150 | » | 1 |
| » | » | » | » | » | » | S. 200 | 100 | » | 1 |
| 4089 | 40°29′ N. | 14°16′ E. | 1000 | 26-5-30 | $23^{20}$ | S. 200 | 250 | 90 | 1 |
| » | » | » | 1000—1025 | 26/27-5-30 | $23^{20}$ $1^{20}$ | S. 200 | 200 | » | 2 |
| » | » | » | » | » | » | S. 200 | 150 | » | 2 |
| » | » | » | » | » | » | S. 200 | 100 | » | 2 |
| 4107 | 40°28′ N. | 14°15′ E. | 1040—950 | 27/28-5-30 | $22^{45}$ $0^{45}$ $2^{45}$ | S. 200 | 200 | 90 | 2 |
| » | » | » | » | » | » | S. 200 | 100 | » | 2 |
| 4119 | 40°13′ N. | 12°06′ E. | 3200 | 30-5-30 | $17^{20}$ | P. 100 | 600 | 45 | 5 |
| » | » | » | 2700 | » | $19^{45}$ | S. 150 | 3000 | 120 | 1 |
| » | » | » » | 3350 | » | $23^{30}$ | S. 200 | 600 | 90 | 1 |
| » | » | » | 2400 | 31-5-30 | $1^{50}$ | S. 200 | 200 | » | 2 |
| 4121 | 38°22′ N. | 13°04′ E. | 950 | 1-6-30 | $0^{50}$ | S. 200 | 250 | 120 | 1 |
| 4122 | 38°27′ N. | 10°20′ E. | 2000 | 1-6-30 | $20^{00}$ | S. 200 | 150 | 90 | 2 |
| 4123 | 38°20′ N. | 10°16′ E. | 1200 | 1-6-30 | $22^{30}$ | S. 200 | 250 | 90 | 1 |
| » | » | » | » | » | » | S. 200 | 150 | » | 1 |

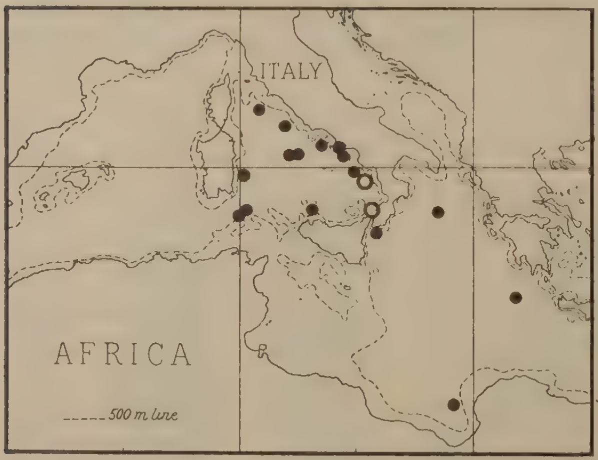

Chart 20. Occurrence of *Callizona Moebii* Apstein.
● new records. ○ previous records.

The average length of the present specimens is abt. 6—7 cm. by only 1 or 2 mm. The "tail" is filiform with reduced parapodia. The colour is transparent yellowish, the enormous eyes red with sidewards turned cornea. The segmental glands are very often quite colourless and inconspicuous. The proboscis is fleshy, trumpet-like, with 12 round papillæ. The prostomium is rather large, conical, with 4 stout antennæ and one small, digitiform, unpaired antenna. 5 pairs of tentacular cirri, the first pair on the first segment and the two ventral on the following two segments are considerably shorter than the dorsal ones of segments, 2 and 3. All the chaetigerous segments are provided with large foliaceous, ovato-cordiform cirri, the dorsal greater than the ventral and often distinctly imbricate, especially in the foremost part of the body. Two kinds of bristles; the acicular uncompound and curved, the hirsute very long and slender and compound, the end piece very long. In the first feet abt. 3—5, in the following only 1—2 acicular setæ. The much elongated and conical pedal lobe ends in a little cirriform appendage.

The species was described by APSTEIN 1893 from Messina and the Gulf of Naples, and it seems not to have been reported later on from the Mediterranean. In the present material a fairly large number are present, nearly all from the Tyrrhenian and Ionian Seas. According to the appearence of this beautiful form and the list given above it is an oceanic species, most frequently occurring at the surface or close to it. It has been taken both during the summer and winter cruises, and especially in the evening or night.

The distribution of *C. Moebii* is insufficiently known. The best information is got from APSTEIN (1900) who has reported a series of localities in the Atlantic.

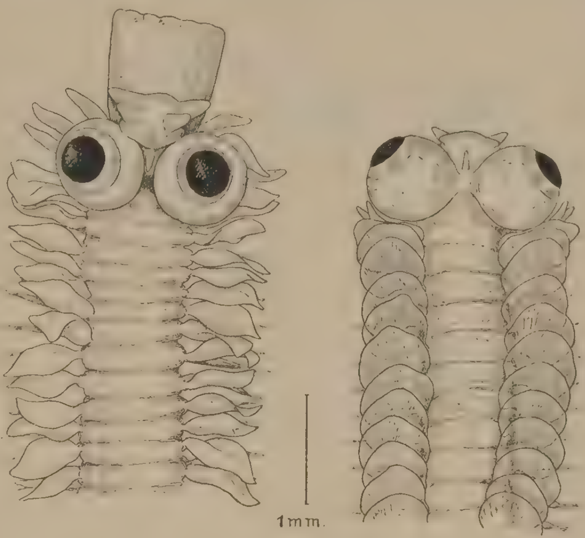

Fig. 26. *Callizona Moebii* Apstein. Dorsal views.

## CALLIZONA ANGELINI (Kinberg).

*Krohnia angelini* Kinberg 1866, p. 243.
*Rhynchonerella angelini* Greeff 1876, p. 57.
*Callizona Grubei* Greeff 1876, p. 72.
*Callizona angelini* Apstein 1892, p. 44.
*Callizona angelini* Apstein 1900, p. 18.
*Callizona angelini* Southern 1911, p. 4.
*Callizona angelini* Fauvel 1916, p. 68.
*Callizona angelini* Fauvel 1923, p. 215.
*Callizona angelini* Monro 1930, p. 82.
*Callizona angelini* Fauvel 1932, p. 17.

Material.

| Station Nr. | Lat. | Long. | Depth Metres | Date | Hour | Gear | Wire out Metres | Duration of haul in minutes | Number of specimens |
|---|---|---|---|---|---|---|---|---|---|
| "Thor" | | | | | | | | | |
| 52 | 48°43′ N. | 12°05′ W. | 1945 | 21-5-06 | $6^{10}$ | Y. 330 | 300 | 120 | 1 |
| 62 | 50°25′ N. | 12°44′ W. | 2775 | 5-6-06 | $2^{45}$ | Y. 330 | 1500 | 120 | 1 |
| 65 | 35°53′ N. | 7°26′ W. | 1300 | 24-2-09 | $5^{50}$ | Y. 200 | 25 | 30 | 1 |
| 66 | 36°16′ N. | 6°52′ W. | 735 | 25-2-09 | $5^{15}$ | Y. 200 | 600 | 120 | 1 |
| 81 | 41°32′ N. | 9°32′ W. | 2140 | 15-6-10 | $4^{00}$ | Y. 200 | 300 | 30 | 2 |
| 87 | 37°03′ N. | 9°15′ W. | 1580 | 17-6-10 | $13^{30}$ | Y. 200 | 300 | 30 | 1 |
| 91 | 35°53′ N. | 7°26′ W. | 1225 | 18-6-10 | $18^{55}$ | Y. 200 | 300 | 45 | 3 |

One of the largest specimens measures 115 mm. by 8 mm. inclusive of the feet. Characteristic is the gradual tapering of the body into a 12—15 mm. long whipcord-like "tail" (figured by APSTEIN (1892, pl. V)). The colour is yellow, body not transparent, the brown segmental glands in some specimens hardly visible, in others forming a long narrow, black brown band on each side of the body. The eyes are red. The greatest breadth is generally about 10 segments behind the head. Prostomium forms a little globular knot with four blunt short antennæ, equally long; the unpaired antenna is shorter than the other 4. The proboscis stout, fleshy with a crown of abt. 12 rounded protrusions and the same number of

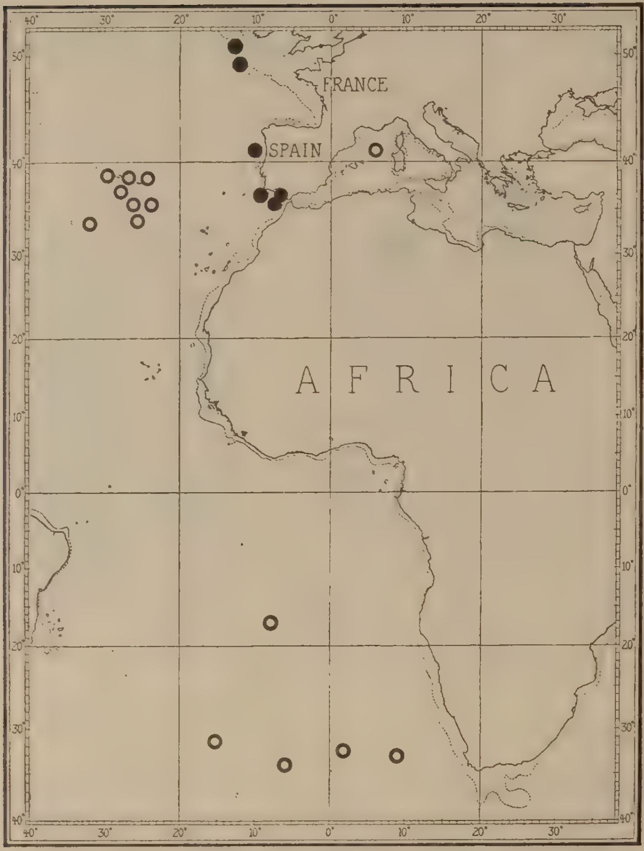

Chart 21. Occurrence of *Callizona angelini* (Kinberg).
● new records. ○ previous records.

longitudinal striations. 5 pairs of tentacular cirri, those ventrally placed a little shorter than those dorsally placed. The feet are all similar, carrying enormous foliaceous dorsal cirri, cordiform or egg-shaped, and more oval or lanceolate ventral cirri. Towards the "tail" these cirri gradually become smaller; in the last ca. 10—15 segments they are totally lacking. The pedal lobe is elongated, ending in the cirriform appendage characteristic of the genus, and which in the middle, best developed feet is almost as long as half of the stem. Two sorts of setæ, both compound: coarse, acicular bristles with minute end-pieces and long, slender hirsute bristles. In one of the specimens the arrangement of the bristles was as follows: 1st chaetiger 8 acicular, 10 hirsute bristles; 2nd chaetiger 17 acicular, abt. 20 hirsute bristles; 3rd chaetiger 15 acicular, 13 hirsute bristles; in the following segments the number of acicular bristles is gradually reduced to 2 or 3, and the swimming bristles increase to 50—60. The acicular setæ are always ventrally placed in the parapodia.—In some of the specimens the feet were filled with ripe ova.

The specimens all come from the Atlantic, partly west of England and partly from the coast of Portugal and the Gulf of Cadiz. The species was previously known from the Mediterranean and it is evidently fairly common in the Atlantic (especially round the Azores). Monro reports it from several localities in the southern part of the Atlantic.—Indian Ocean; Chinese waters.

## CALLIZONA NASUTA Greeff.

*Rhynchonorella gracilis* da Costa 1861, p. 168.
*Callizona nasuta* Greeff 1876, p. 72.
*Callizona nasuta* Apstein 1900, p. 19.
*Callizona Henseni* Apstein 1900, p. 20.
*Callizona nasuta* Southern 1911, p. 6.
*Callizona nasuta* Fauvel 1923, p. 215.

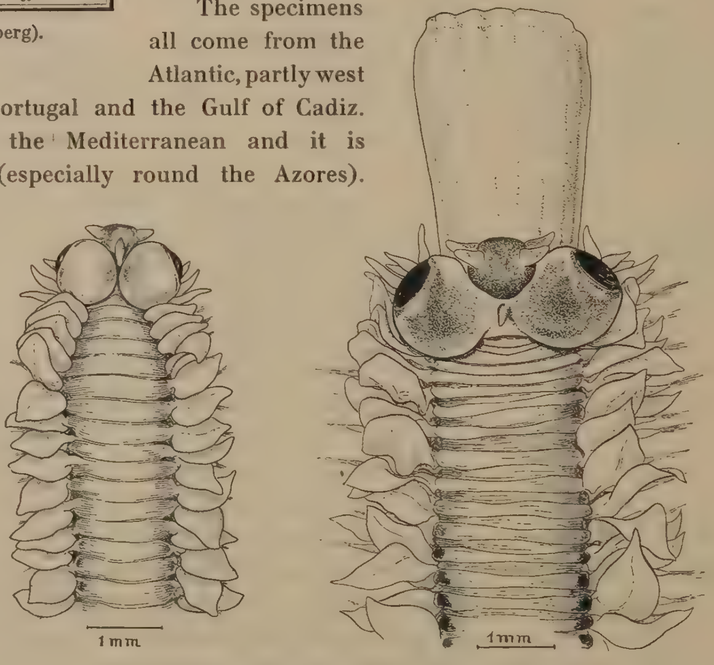

Fig. 27. *Callizona angelini* (Kinberg). Dorsal views.

Material.

| Station Nr. | Lat. | Long. | Depth Metres | Date | Hour | Gear | Wire out Metres | Duration of haul in minutes | Number of specimens |
|---|---|---|---|---|---|---|---|---|---|
| "Dana" | | | | | | | | | |
| 4055 | 38°12.5′ N. | 15°36′ E. | 105—135, 125 | 6-5-30 | $3^{30}$ $5^{30}$ | S. 200 | 100 | 90 | 1 |

The body of the single specimen is long (according to FAUVEL 1923 3—6 cm.), filiform, 0.75 mm. broad, much damaged; it has broken into three fragments, the hindmost part is not present. Prostomium distinctly marked off, projecting far in front of the eyes, club-shaped and with two rows of pigment spots. It carries on the anterior border 4 equally long subulate antennæ and one long digitiform antenna between the eyes. Proboscis long, fleshy with about 12 small papillæ, no longitudinal striation. The 1st pair of tentacular cirri on the first segment is much shorter than the others and inserted beneath the eyes; the following two segments each carries two pairs of tentacular cirri, the dorsal much longer than the ventral ones. The cirri of the chaetigers are foliaceous and only slightly imbricate. In the first chaetiger 2 acicular, simple setæ (in contradistinction to the two other species) and a number of long, composite bristles. Owing to the bad state of preservation I am not able to give any further account of this interesting species. The shape of the head however is sufficient for the specific determination, and it is possible to decide that the specimen is fully grown, primarily because there are no small setæ between the tentacular cirri and secondly owing to the wide projecting prostomium (in juvenile forms it is much smaller). The segmental glands are well developed.

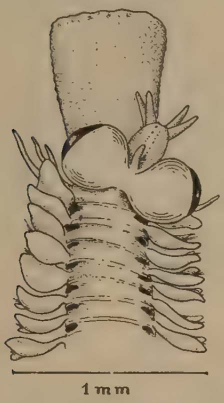

Fig. 28. *Callizona nasuta* Greeff. Dorsal view.

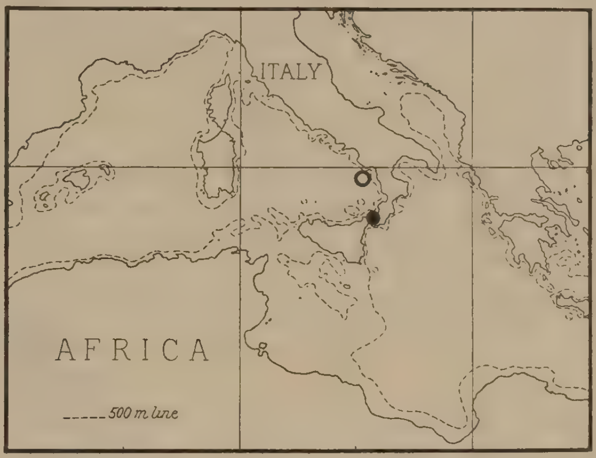

Chart 22. Occurrence of *Callizona nasuta* Greeff.
● new record. ○ previous record.

DA COSTA (1861) has described the species (under the name of *Rhynchonerella gracilis*) from the Gulf of Naples. To my knowledge it has not been found later in the Mediterranean. The present single find is from the Strait of Messina. It is evidently very rare.

Its further distribution is the tropic and temperate zones of the Atlantic. SOUTHERN (1911) mentions it from off Ireland.

## [ CALLIZONA SETOSA (Greeff).

This species was previously known from the Mediterranean and adjacent waters from which the material here worked out originates; it is—however—not represented in the samples. It is distinguished from the three other *Callizona*-species here mentioned by its much smaller size: only 15—20 mm. by 0.4—0.5 mm. According to FAUVEL (1923, p. 214) it is most closely related to *C. angelini* on account of the compound acicular bristles; in *C. angelini* the end-piece of these bristles is however very fine and delicate and not denticulated, whereas the end-piece in *C. setosa* is broad and short with a denticulate concave border. ]

# Additional Note on *Chloeia venusta* of the

## Family AMPHINOMIDAE Savigny.

### **CHLOEIA VENUSTA** Quatrefages.

*Chloeia fucata* McIntosh 1874, p. 395.
*Chloeia venusta* Marenzeller 1893, p. 2.
*Chloeia venusta* Fauvel 1923, p. 134.

Material.

| Station Nr. "Thor" | Lat. | Long. | Depth Metres | Date | Hour | Gear | Wire out Metres | Duration of haul in minutes | Number of specimens |
|---|---|---|---|---|---|---|---|---|---|
| 105 | 36°43′ N. | 2°08′ W. | 20 | 24-6-10 | $19^{50}$ | Y. 200 | 40 | 15 | 3 |

The species is not pelagic; it may be regarded as accidental, that it has been taken in the young-fish trawl. The specimens are of the same length. abt. 11 mm. and have only abt. 20 segments. Normally the number is 25 and the length of the worm 20—25 mm. (Fauvel 1923). There is no doubt that the three specimens to hand are juvenile forms; this may explain their pelagic occurrence. The very long and hairlike ventral bristles are gold glimmering. The caroncle reaches as far backwards as to the limit between the 3rd and 4th segment. The unpaired antenna is subulate and only abt. one third of the length of the caroncle.

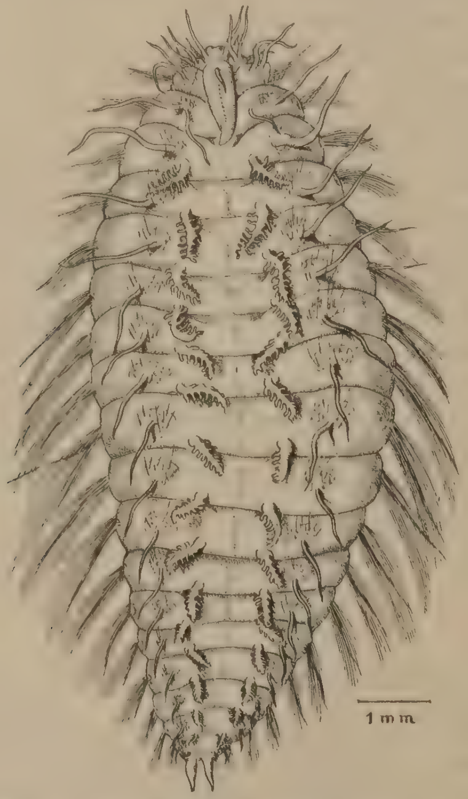

Fig. 29. *Chloeia venusta* Quatrefages. Dorsal view.

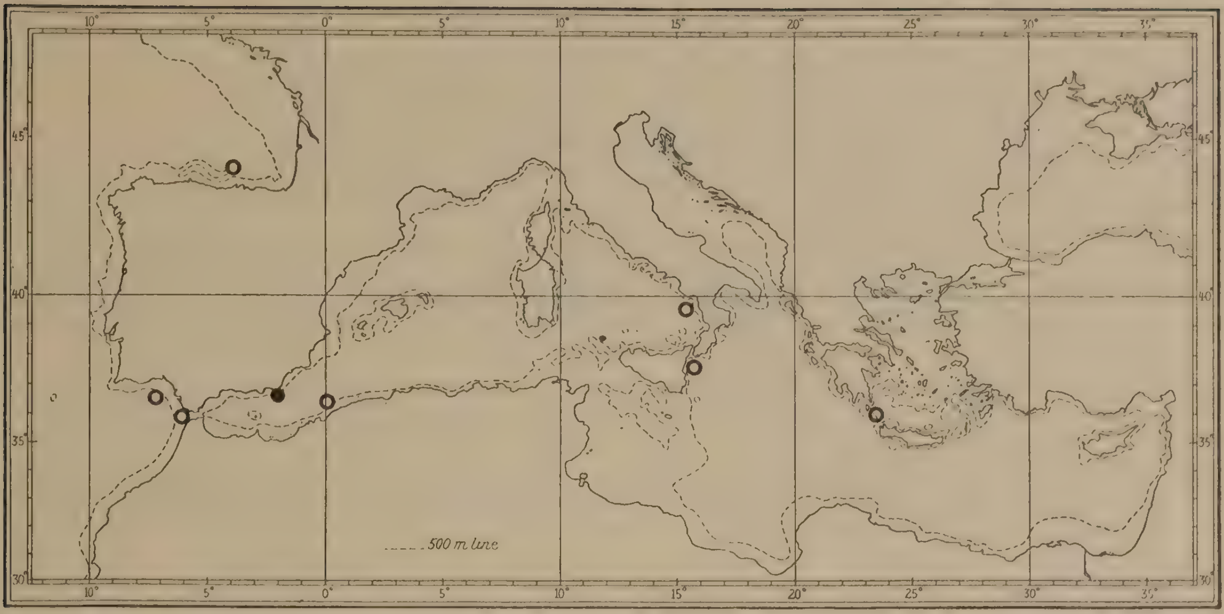

Chart 23. Occurrence of *Chloeia venusta* Quatrefages.
● new record. ○ previous records.

The single record is from shallow water in the Alboran Sea. The species was previously known from several localities in the Mediterranean; MARENZELLER (1893) reports it from Cerigo and McINTOSH (1874) from Algeria and Tangier and FAUVEL from Naples and Sicily. Further, the species is known from the Atlantic, viz. Santander (FAUVEL) and the Gulf of Cadiz (McINTOSH).

# LIST OF LITERATURE

Apstein, C. 1891. Die Alciopiden des naturhistorischen Museum in Hamburg. Jahrb. Hamburg. Wiss. Anst. 8.

— 1892. Callizona Angelini (Kbg.) Apstein. Festschr. zum 70sten Geburtstage Rudolf Leuckarts. Leipzig.

— 1893. Die Alciopiden der Berliner zoologischen Sammlung. Arch. f. Naturgeschichte 1893.

— 1900. Die Alciopiden u. Tomopteriden der Plankton-Expedition. Ergebn. d. Plankt. Exp. d. Humboldt-Stiftung. 2 H. b.

Bergstrøm, E. 1914. Zur Systematik der Polychætenfamilie der Phyllodocidæ. Zool. Bidr. från Uppsala 3.

Lo Bianco, S. 1904. Pelagische Tiefseefischerei der "Maja" in der Umgebung von Capri. Beitr. z. Kenntniss des Meeres u. seiner Bewohner. I.

Chamberlin, R. 1919. The Annelida Polychæta of the "Albatross" Expedition. Mem. Mus. Comp. Zool. Harvard Coll. 48.

Claparède, E. 1868—70. Annélides Chétopodes du Golfe de Naples. Mém. Soc. Phys. de Genève 19 and 20; supplem. 1870 ibid. vol. 20.

da Costa, O. G. 1861. Annuario del Museo zoologica della reale università di Napoli. I.

— 1862—1864—1867. Illustrazione iconografica degli Annelidi rari o poco conosciuti del Golfo di Napoli. Annuario d. Mus. Zool. Napoli II og IV.

Ehlers, E. 1912. Polychæta. National antarctic Exped. 6.

— 1913. Die Polychaeten-Sammlungen der Deutschen Südpolarexpedition 1901—03. Deutsche Süd-Polar-Exp. 13 (4).

Fauvel, P. 1914. Annélides polychètes non pélagiques provenant des Campagnes de l'"Hirondelle" et de la "Princesse Alice" 1885—1910. Rés. des Camp. Sci. du Prince de Monaco 46.

— 1915. Polychètes pélagiques nouvelles des Campagnes de la "Princesse Alice". Bull. Inst. Océanogr. Monaco No. 305.

— 1916. Annélides polychètes pélagiques provenant des campagnes des Yachts "Hirondelle" et Princesse "Alice". Rés. des Camp. Sc. du Prince de Monaco 48.

— 1923. Polychètes errantes. Faune de France 5.

— 1932 a. Annélides polychètes provenant des Campagnes de l'"Hirondelle II" (1911—15). Rés. des Camp. Sc. du Prince de Monaco 85.

— 1932 b. Annelida Polychaeta of the Indian Museum, Calcutta. Mem. Ind. Mus. 12.

— 1934. Annélides polychètes de Rovigno d'Istria. Thalassia 1.

Granata, L. 1911. Raccolte planctonische fatte della R. Nave "Liguria" 2 fasc. III. Annelides.

Greef, R. 1876. Untersuchungen über die Alciopiden. Nova acta d. K. Leop. Carol. D. Akad. 39.

Grube, E. 1855. Beschreibungen neuer oder weniger bekannten Anneliden. Arch. f. Naturges. 21.

Hering, E. 1892. Zur Kenntniss der Alciopiden von Messina. Sitzber. d. Kaiserl. Akad. d. Wiss. Wien. Mathem.-Naturw. Cl. 101 Abt. 1.

McIntosh, W. C. 1874. On the Annelida of the "Porcupine" Expedition of 1869 and 1870. Trans. Zool. Soc. Lond. 9.

— 1885. Annelida Polychæta. Challenger Reports. Zool. 12.

— 1900. The British Annelids. Vol. I. Ray Soc. London.

Introduction to The Carlsberg Foundation's Oceanographical expedition round the World 1928—30 and previous "Dana"-Expeditions. Dana-Report No. 1. 1934.

Kinberg, I. G. H. 1864—1866. Annulata nova. Öfvs. Vetensk. Akad. Förhandl.

Krohn, A. 1845. Zoologische und anatomische Bemerkungen über die Alciopiden. Arch. f. Naturges. Jahrg. 11.

Levinsen, G. M. R. 1885. Om nogle pelagiske Annelider. D. kgl. Danske Vidensk. Selsk. Skr. 6. Række, Afd. 3. No. 2.

Marenzeller, E. von. 1892—1893. Polychæten des Grundes. Denkschr. d. Math.-Naturw. Cl. der K. Akad. d. Wiss. Wien 60.

Monro, C. C. A. 1930. Polychæte worms I. Discovery Reports. 2.

— 1936. Polychæte worms II. Discovery Reports 12.

Quatrefages, A. de. 1865. Histoire naturelle des Annelés marins et d'eau douce. 3 vols. Paris.

Reibisch, J. 1895. Die pelagischen Phyllodociden u. Typhloscoleciden der Plankton-Exped. Ergebn. d. Plankton-Exped. d. Humboldt-Stiftung 2. H. c.

Schmidt, Johs. 1912. Introduction. Report on the Danish Oceanographical expeditions 1908—10 to the Mediterranean and adjacent seas 1.

Southern, R. 1909. Polychæta of the Coast of Ireland II. Pelagic Phyllodocidæ. Fisheries, Ireland. Sci. Invest.

— 1910. Alciopinæ, Tomopteridæ, and Typhloscolecidæ. Fisheries Ireland Sci. Invest.

— 1914. Archiannelida and Polychæta. Clare Isl. Survey. Proc. R. Irish Acad. 31.

Viguier, C. 1885. Sur les Annélides pélagiques de la baie d'Alger. Compt. rend. 101.

— 1886. Études sur les animaux inférieurs de la baie d'Alger. Arch. Zool. Expér. 2$^{e}$ Sér. 4.

— 1911. Nouvelles études sur le Plancton de la Baie d'Alger. Ann. Sc. Nat. Zool. 9$^{e}$ Sér. 15.

Wesenberg-Lund, E. 1935. Tomopteridæ and Typhloscolecidæ. The Danish Ingolf-Expedition. 4 No. 11.

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# Postscript.

The first volume of these reports (Vol. I, containing Introduction, Hydrography etc.) appeared in 1912 under the editorship of the late Professor Johs. Schmidt, leader of the Danish expeditions with the research-vessel „Thor" to the Mediterranean in 1908—10. Throughout the following years until his death in 1933 Johs. Schmidt saw published the series of publications, which resulted from the investigation by many collaborators of the material collected. In the course of years certain of these publications also included other materials collected later by other expeditions to the same waters. The publication of the reports has always been supported and the expense defrayed by the Carlsberg Foundation.

At the death of Johs. Schmidt, however, not all the material had been worked up and it was then decided by the Carlsberg Foundation, that a final volume should contain those reports, whose completion was expected within a few years, whilst the remainder of the material from the Mediterranean expeditions should be combined with the material from the Carlsberg Foundation's Expedition round the world in the years 1928—30, during which several investigations were also made in the Mediterranean. The reports which may be expected later, will therefore be published in the series: „The Carlsberg Foundation's Oceanographical Expedition round the world 1928—30 and previous „Dana" Expeditions" (Dana-Report).

The papers published in a last volume (Siphonophorae, Euphausiacea and Pelagic Polychaetes) will therefore be the last of the publications to appear under the title borne by the present work. Altogether this work now contains 46 publications of ca. 2,750 pages in 9 volumes. From the list of contents preceding the different volumes, and from the General Index of the papers given on the following page, readers will be able to see, which animal groups have been dealt with and which not in the present report of the Expeditions.

In addition to the papers included in the present work, however, a series of small and large publications have appeared in certain scientific periodicals and other scientific publications, either entirely or partially based on the material of the „Thor" Expeditions, and the present volume (Vol. III) contains a list of the principal of these papers, so that interested readers will have here the opportunity of finding information regarding any results from the Expeditions, which are not included in the report of the Expedition itself.

*Copenhagen, March 1939.*

A. Vedel Tåning.
Dr. phil.

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BØGGILD, O. B.: The Deposits of the Sea-Bottom. 1912. Vol. I (III).

DEGNER, EDUARD: Cephalopoda. 1926. Vol. II. C, 1.

EGE, VILH.: Stomiatidæ (Stomias). 1918. Vol. II. A, 4.
Sudidæ (Paralepis). 1931. VOL. II. A, 13.

EHRENBAUM, E.: Scombriformes. 1924. Vol. II. A, 11.

FAGE, L.: Shore Fishes. 1918. Vol. II. A, 3.
Engraulidæ, Clupeidæ. 1920. Vol. II. A, 9.

GUITEL, F.: Lepadogaster. 1920. Vol. II. A, 8.

Hydrographical Observations. 1912. Vol. I. (II, 1).

JACOBSEN, J. P.: The amount of Oxygen in the water of the Mediterranean. 1912. Vol. I (II, 5).

JESPERSEN, P.: Sternoptychidae (Argyropelecus and Sternoptyx). 1915. Vol. II. A, 2.
On the quantity of Macroplankton in the Mediterranean and the Atlantic. 1923. Vol. III, 3.
and TÅNING, Å. VEDEL: Mediterranean Sternoptychidæ. 1926. Vol. II. A, 12.

JÖRGENSEN, E.: Mediterranean Ceratia. 1920. Vol. II. J, 1.
Mediterranean Dinophysiaceae. 1923. Vol. II. J, 2.
Mediterranean Tintinnidae. 1924. Vol. II. J, 3.

KRAMP, P.: Medusæ. 1924. Vol. II. H, 1.

KYLE, H. M.: Flat-Fishes (Heterosomata). 1913. Vol. II. A, 1.

LEMOINE, Mme PAUL: Calcareous Algae. 1915. Vol. II. D, 1.

NIELSEN, J. N.: Hydrography of the Mediterranean and adjacent waters. 1912. Vol. I (II, 2).

OSTENFELD, C. H.: Sea-Grasses. 1918. Vol. II. K, 2.

PALITZSCH, SVEND: Determination of the quantity of Oxygen in Seawater (Methods used). 1912. Vol. I (II, 4).
Measurement of the Hydrogen Ion Concentration in Seawater. 1912. Vol. I (II, 6).

PAVILLARD, J.: Bacillariales. 1926. Vol. II. J, 4.

PETERSEN, H. E.: Algæ (excl. Calcareous Algæ). 1918. Vol. II. K, 3.

PLATANIA, G.: Experiments with drift-bottles (2nd Report). 1923. Vol. III, 5.

RUUD, JOHAN T.: Euphausiacea. 1936. Vol. II. D, 6.

SCHMIDT, JOHS.: Introduction. 1912. Vol. I (I).
Experiments with drift-bottles (1st Report). 1913. Vol. III, 1.
Argentinidæ, Microstomidæ, Opisthoproctidæ, Mediterranean Odontostomidæ. 1918. Vol. II. A, 5.
and STRUBBERG, A. C.: Mediterranean Bramidæ and Trichiuridæ. 1918. Vol. II. A, 6.

SCHNAKENBECK, W.: Carangidæ. 1931. Vol. II. A, 14.

SPARCK, R.: Some quantitative investigations on the bottom fauna of the west coast of Italy, in the Bay of Algiers, and at the coast of Portugal. 1931. Vol. III, 7.

STEPHENSEN, K.: Isopoda, Tanaidacea, Cumacea, Amphipoda (excl. Hyperiidea). 1915. Vol. II. D, 1.
Hyperiidea-Amphipoda (part 1). 1918. Vol. II. D, 2.
Decapoda-Macrura (excl. Sergestidæ). 1923. Vol. II. D, 3.
Hyperiidea-Amphipoda (part 2). 1924. Vol. II. D, 4.
Hyperiidea-Amphipoda (part 3). 1926. Vol. II. D, 5.

STRUBBERG, A. C.: Elvers from North and South Europe. 1923. Vol. III, 4.

THOMSEN, HELGE: Nitrate and Phosphate contents of Mediterranean water. 1931. Vol. III, 6.

TÅNING, Å. VEDEL: Mediterranean Scopelidæ. 1918. Vol. II. A, 7.
Lophius. 1923. Vol. II. A, 10.

WESENBERG-LUND, ELISE: Pelagic Polychaetes of the families Aphroditidae, Phyllodocidae, Typhloscolecidae and Alciopidae. 1939. Vol. II. E, 1.

WINGE, O.: The Sargasso Sea, its boundaries and vegetation. 1923. Vol. III, 2.

# List of other Papers resulting in whole or in part from the Cruises of the Danish Research-Steamer "Thor" in the Atlantic and Mediterranean.

## 1. Hydrography.

J. P. JACOBSEN, in Schmidt, Nielsen og Jacobsen: Fra den danske oceanografiske Expedition til Middelhavet i Vinteren 1908—1909. (Geografisk Tidsskrift, 20. H. VI, København 1910).

MARTIN KNUDSEN: Danish Hydrographical Investigations at the Faroe Islands in the Spring of 1910. (Meddelelser fra Kommissionen for Havundersøgelser, Serie: Hydrografi, II, No. 1, København 1911.

J. N. NIELSEN: Hydrography of the Waters by the Faroe Islands and Iceland during the cruises of the Danish research-steamer "Thor" in the summer 1903 (ibid. I, No. 4, 1904).

— Contributions to the Hydrography of the Waters north of Iceland (ibid. I, No. 7, 1905).

— Contribution to the Hydrography of the north-eastern part of the Atlantic Ocean (ibid. I, No. 9, 1907).

— Contribution to the understanding of the currents in the northern part of the Atlantic Ocean (ibid. I, No. 11, 1908).

— in Schmidt, Nielsen og Jacobsen: Fra den danske oceanografiske Expedition til Middelhavet i Vinteren 1908—1909 (Geografisk Tidsskrift, 20, H. VI, København 1910).

— Sur les températures des grandes profondeurs particulièrement dans la Méditerranée. Note préliminaire (Bulletin de l'Institut Océanographique, No. 209, Monaco 1911).

— Hydrografiske Undersøgelser i Middelhavet; De danske oceanografiske Expeditioner i 1908—1910, København 1913.

Numerous observations, sections, etc. from the "Thor" Expeditions in the Atlantic have been published in: Bulletin Hydrographique du Conseil Permanent International pour l'Exploration de la Mer, København 1902 and following years.

## 2. Biology.

VILH. EGE: On the postlarval stages of the species of *Paralepis* inhabiting the North Eastern part of the Atlantic incl. the Mediterranean (Videnskabelige Meddelelser fra Dansk naturhistorisk Forening, Vol. 69, København 1918).

P. JESPERSEN: Contributions to the Life-History of the North Atlantic Halibut (*Hippoglossus vulgaris* Flem.) (Meddelelser fra Kommissionen for Havundersøgelser, Serie: Fiskeri, Bind V, No. 5, København 1917).

— On the Occurrence of the Postlarval Stages of the Herring and the "Lodde" (*Clupea harengus* L., and *Mallotus villosus* O. F. M.) at Iceland and the Færoes (ibid. Bind VI, No. 1, 1920).

P. JESPERSEN and Å. VEDEL TÅNING: Some Mediterranean and Atlantic *Sternoptychidae*. (Videnskabelige Meddelelser fra Dansk naturhistorisk Forening, Vol. 70, København 1919).

C. H. OSTENFELD: *Thorosphaera*, eine neue Gattung der Coccolithophoriden (Berichte der deutschen Botanischen Gesellschaft, Bd. 28, Berlin 1910).

OVE PAULSEN: Plankton-Investigations in the Waters round Iceland in 1903 (Meddelelser fra Kommissionen for Havundersøgelser, Serie: Plankton, I, No. 1, København 1904).

— On some Peridineae and Planktons Diatoms (ibid. I, No. 3, 1905).

— Studies on the biology of *Calanus finmarchicus* in the waters round Iceland (ibid. I, No. 4, 1906).

— Plankton Investigations in the Waters round Iceland and in the North Atlantic in 1904 (ibid. I, No. 8, 1909).

— The plankton on a submarine bank (in Biologiske Arbejder tilegnede Eug. Warming d. 3. Nov. 1911, København 1911).

C. G. JOH. PETERSEN: On the Larval and Postlarval Stages of the Long Rough Dab and the Genus *Pleuronectes* (Meddelelser fra Kommissionen for Havundersøgelser, Serie: Fiskeri, I, No. 1, København 1904).

C. G. JOH. PETERSEN: Larval Eels (*Leptocephalus brevirostris*) of the Atlantic Coasts of Europe (ibid. I, No. 5, 1905).

— On the young stages of the Genus *Zeugopterus* (Report of the Danish Biological Station, XII, København 1905).

— On the Larval and Post-Larval Stages of some *Pleuronectidae* *Pleuronectes, Zeugopterus*) (Meddelelser fra Kommissionen for Havundersøgelser, Serie: Fiskeri, II, No 1, København 1906).

— On the Larval and Postlarval Stages of some *Pleuronectidae* (*Zeugopterus, Arnoglossus, Solea*) (ibid. III, No. 1, 1909).

LOUIS ROULE: Étude sur les formes larvaires Tiluriennes de Poissons Apodes recueillies par le "Thor" (Annales de l'Institut Océanographique, T. VI, Fasc. 2, Monaco 1913).

JOHS. SCHMIDT: Fiskeriundersøgelser ved Island og Færøerne i Sommeren 1903 (Skrifter udgivne af Kommissionen for Havundersøgelser, No. 1, København 1904).

— On Pelagic Post-Larval Halibut (*Hippoglossus vulgaris* Flem. and *H. hippoglossoides* [Walb.]) (Meddelelser fra Kommissionen for Havundersøgelser, Serie: Fiskeri, I, No. 3, København 1904).

— The Pelagic Post-Larval Stages of the Atlantic Species of *Gadus*, Part I (ibid. I, No. 4, 1905).

— On the Larval and Post-Larval Stages of the Torsk (*Brosmius brosme* [Ascan.]) (ibid. I, No. 8, 1905).

— The Pelagic Post-Larval Stages of the Atlantic Species of *Gadus*, Part II (ibid. II, No. 2, 1906).

— On the Pelagic Post-Larval Stages of the Lings (*Molva molva* [Linné] and *Molva byrkelange* [Walb.]) (ibid. II, No. 3, 1906).

— On the Larval and Post-Larval Development of the Argentines (*Argentina silus* [Ascan.] and *Argentina sphyræna* Linné with notes on *Mallotus villosus* [O. F. Müll.]) (ibid. II, No. 4, 1906).

— Contribution to the Life-History of the Eel (*Anguilla vulgaris* Turt.) (Rapports et Procès-Verbaux du Conseil International pour l'Exploration de la Mer, Vol. V, No. 4, København 1906).

— Marking Experiments on Plaice and Cod in Icelandic Waters (Meddelelser fra Kommissionen for Havundersøgelser, Serie: Fiskeri, II, No. 6, København 1907).

— On the Post-Larval Development of the Hake (*Merluccius vulgaris* Flem.) (ibid. II, No. 7, 1907).

— On the Post-Larval Development of some North Atlantic Gadoids (*Raniceps raninus* [Linné] and *Molva elongata* [Risso]) (ibid. II, No. 8, 1907).

— On the Post-Larval Stages of the John Dory (*Zeus faber* L.) and some other Acanthopterygian Fishes (ibid. II, No. 9, 1908).

— Remarks on the Metamorphosis and Distribution of the Larvae of the Eel (*Anguilla vulgaris* Turt.) (ibid. III, No. 3, 1909).

— On the Occurrence of Leptocephali (Larval Muraenoids) in the Atlantic W. of Europe (ibid. III, No. 6, 1909).

— On the Distribution of the Fresh-Water Eels (*Anguilla*) throughout the World, I. Atlantic Ocean and Adjacent Regions (ibid. III, No. 7, 1909).

— The Distribution of the Pelagic Fry and the Spawning Regions of the Gadoids in the North Atlantic from Iceland to Spain (Rapports et Procès-Verbaux du Conseil International pour l'Exploration de la Mer, Vol. X, No. 4, København 1909).

— Exposé sommaire des travaux de l'expédition océanographique danoise dans la Méditerranée (1908—1909) (La Géographie, XXI, 2, Paris 1910).

— *Leptocephalus hyoproroïdes* and *Lept. thorianus* (Zoologischer Anzeiger, XXXVI, No. 2—3, Leipzig 1910).

— Résultats préliminaires de l'expédition océanographique danoise dans l'Atlantique et la Méditerranée pendant l'été 1910 (La Géographie, Paris 1911).

JOHS. SCHMIDT: Biology of the Eel-fishes, especially of the Conger (Nature, vol. 86, London 1911).

— Fünf Jahre dänischer Untersuchungen über die Biologie der aalartigen Fische (Fischerbote, No. 12, Hamburg 1911).

— Contributions to the Biology of some North Atlantic Species of Eels (Videnskabelige Meddelelser fra den Naturhistoriske Forening, Vol. 64, København 1912).

— On the Larval Form of *Chlopsis bicolor* Raf. (ibid. vol. 64, 1912).

— Danske Undersøgelser i Atlanterhavet og Middelhavet over Ferskvandsaalens Biologi (Skrifter udgivne af Kommissionen for Havundersøgelser, No. 8, København 1912).

— Danish Researches in the Atlantic and Mediterranean on the Life-History of the Freshwater-Eel (*Anguilla vulgaris*, Turt.) (Internationale Revue der gesamten Hydrobiologie und Hydrographie, V, Leipzig 1912).

— Über die Fortpflanzung des Aals und seine Laichplätze (Fischerbote, IV, No. 7, Hamburg 1912).

— The Reproduction and Spawning-Places of the Fresh-Water Eel (*Anguilla vulgaris*) (Nature, London, August 22, 1912).

— Sur la reproduction et les lieux de ponte de l'Anguille vulgaire (Bulletin de la Société Centrale d'Aquiculture et de Pêche, Tome XXIV, No. 9—10, Paris 1912).

— Åalens forplantning och lekplatser (Svensk Fiskeri Tidsskrift, Häft, I, 1913).

— On the Identification of Muraenoid Larvae in their Early ("Preleptocephaline") Stages (Meddelelser fra Kommissionen for Havundersøgelser, Serie: Fiskeri, IV, No. 2, København 1913).

— First Report on Eel Investigations (Rapports et Procès-Verbaux du Conseil International pour l'Exploration de la Mer, Vol. XVIII, København 1913).

— On the Classification of the Fresh-Water Eels (*Anguilla*) (Meddelelser fra Kommissionen for Havundersøgelser, Serie: Fiskeri, IV, No. 7, København 1914).

— Second Report on Eel Investigations (Rapports et Procès-Verbaux du Conseil International pour l'Exploration de la Mer, Vol. XXIII, København 1915).

— On the early larval stages of the Fresh-water Eels (*Anguilla*) and some other North Atlantic Murænoids (Meddelelser fra Kommissionen for Havundersøgelser, Serie: Fiskeri, Bind V, No. 4, København 1916).

— The Breeding Places of the Eel (Phil. Transact. Royal Society of London. Series B, Vol. 211, London 1922).

JOHS. SCHMIDT: Aalens Ynglepladser ("Naturens Verden" Bd. VI, København 1922).

— Oceanography of the Gibraltar Region ("Nature". No. 2724, Vol. 109, London 1922).

— Die Laichplätze des Flussaals (Internat. Revue der gesamten Hydrobiologie und Hydrographie. Bd. XI, Leipzig 1923).

— Breeding Places and Migrations of the Eel ("Nature". No. 2776, Vol. 111, London 1923).

— The Transatlantic Migration of the Eel-larvæ ("Nature", London, Jan. 5, 1924).

— L'immigration des larves d'Anguille, dans la Méditerranée, par le détroit de Gibraltar (C. R. des séances de l'Académie des Sciences, tome 179, p. 729, Paris 1924).

— The Breeding Places of the Eel, with Postscript (Smithsonian Report for 1924, p. 279—316, Washington, 1925).

— Eels and Conger Eels of the North Atlantic. ("Nature", October 10, 1931).

A. STRUBBERG: Marking Experiments on Cod at the Færoes (Meddelelser fra Kommissionen for Havundersøgelser, Serie: Fiskeri, V, No. 2, København 1915).

— Marking Experiments on Plaice and Lemon Sole at the Færoes (ibid. Bind V, No. 6, København 1918).

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— Continued Marking Experiments on Plaice and Cod in Icelandic Waters (Meddelelser fra Kommissionen for Havundersøgelser, Serie: Fiskeri, IV, No. 6, København 1913).

— On the Age and Growth of the Cod (*Gadus callarias* L) in Icelandic Waters (ibid., VII, No. 3, København 1923).

— On the Age and Growth of the Coalfish (*Gadus eirens* L), the Norvay Pout (*Gadus Esmarki* Nilsson) and the Poutassou (*Gadus poutassou* Risso) in Icelandic waters (ibid., VIII, No. 7, København 1929).

Å. VEDEL TÅNING: Plaice Investigations in Icelandic Waters (Rapports et Procès-Verbaux des Réunions du Conseil Permanent International pour l'Exploration de la Mer. Vol. LVII, København 1929).

Ö. WINGE: On the Value of the Rings in the Scales of the Cod as a Means of Age Determination, illustrated by Marking Experiment (Meddelelser fra Kommissionen for Danmarks Havundersøgelser, Serie: Fiskeri, IV, No. 8, København 1915).

Plankton-Tables resulting from the "Thor" Expeditions in the Atlantic have been published in: Bulletin des resultats acquis pendant les courses périodiques. Année 1902—03 (supplément), 1903—04, 1904—05, København 1903—05.

JOHS. SCHMIDT: Biology of the Eel-fishes, especially of the Conger (Nature, vol. 86, London 1911).

— Fünf Jahre dänischer Untersuchungen über die Biologie der aalartigen Fische (Fischerbote, No. 12, Hamburg 1911).

— Contributions to the Biology of some North Atlantic Species of Eels (Videnskabelige Meddelelser fra den Naturhistoriske Forening, Vol. 64, København 1912).

— On the Larval Form of *Chlopsis bicolor* Raf. (ibid. vol. 64, 1912).

— Danske Undersøgelser i Atlanterhavet og Middelhavet over Ferskvandsaalens Biologi (Skrifter udgivne af Kommissionen for Havundersøgelser, No. 8, København 1912).

— Danish Researches in the Atlantic and Mediterranean on the Life-History of the Freshwater-Eel (*Anguilla vulgaris*, Turt.) (Internationale Revue der gesamten Hydrobiologie und Hydrographie, V, Leipzig 1912).

— Über die Fortpflanzung des Aals und seine Laichplätze (Fischerbote, IV, No. 7, Hamburg 1912).

— The Reproduction and Spawning-Places of the Fresh-Water Eel (*Anguilla vulgaris*) (Nature, London, August 22, 1912).

— Sur la reproduction et les lieux de ponte de l'Anguille vulgaire (Bulletin de la Société Centrale d'Aquiculture et de Pêche, Tome XXIV, No. 9—10, Paris 1912).

— Ålens forplantning och lekplatser (Svensk Fiskeri Tidsskrift, Häft, I, 1913).

— On the Identification of Muraenoid Larvae in their Early ("Preleptocephaline") Stages (Meddelelser fra Kommissionen for Havundersøgelser, Serie: Fiskeri, IV, No. 2, København 1913).

— First Report on Eel Investigations (Rapports et Procès-Verbaux du Conseil International pour l'Exploration de la Mer, Vol. XVIII, København 1913).

— On the Classification of the Fresh-Water Eels (*Anguilla*) (Meddelelser fra Kommissionen for Havundersøgelser, Serie: Fiskeri, IV, No. 7, København 1914).

— Second Report on Eel Investigations (Rapports et Procès-Verbaux du Conseil International pour l'Exploration de la Mer, Vol. XXIII, København 1915).

— On the early larval stages of the Fresh-water Eels (*Anguilla*) and some other North Atlantic Murænoids (Meddelelser fra Kommissionen for Havundersøgelser, Serie: Fiskeri, Bind V, No. 4, København 1916).

— The Breeding Places of the Eel (Phil. Transact. Royal Society of London. Series B, Vol. 211, London 1922).

JOHS. SCHMIDT: Aalens Ynglepladser ("Naturens Verden" Bd. VI, København 1922).

— Oceanography of the Gibraltar Region ("Nature". No. 2724, Vol. 109, London 1922).

— Die Laichplätze des Flussaals (Internat. Revue der gesamten Hydrobiologie und Hydrographie. Bd. XI, Leipzig 1923).

— Breeding Places and Migrations of the Eel ("Nature". No. 2776, Vol. 111, London 1923).

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— Continued Marking Experiments on Plaice and Cod in Icelandic Waters (Meddelelser fra Kommissionen for Havundersøgelser, Serie: Fiskeri, IV, No. 6, København 1913).

— On the Age and Growth of the Cod (*Gadus callarias* L) in Icelandic Waters (ibid., VII, No. 3, København 1923).

— On the Age and Growth of the Coalfish (*Gadus eirens* L), the Norvay Pout (*Gadus Esmarki* Nilsson) and the Poutassou (*Gadus poutassou* Risso) in Icelandic waters (ibid., VIII, No. 7, København 1929).

Å. VEDEL TÅNING: Plaice Investigations in Icelandic Waters (Rapports et Procès-Verbaux des Réunions du Conseil Permanent International pour l'Exploration de la Mer. Vol. LVII, København 1929).

Ö. WINGE: On the Value of the Rings in the Scales of the Cod as a Means of Age Determination, illustrated by Marking Experiment (Meddelelser fra Kommissionen for Danmarks Havundersøgelser, Serie: Fiskeri, IV, No. 8, København 1915).

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